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VIEWS, NEWS AND INTERVIEWS.

"I am satisfied," said a dentist, "that infinitesimal currents of electricity are set up in the mouth between the saliva and many kinds of food, especially those containing a large proportion of carbon; for instance, toast. I think too that the same currents are produced when teeth fillings of different metals occur in the same person's mouth; furthermore, I believe that the acute relish which we experience when eating certain combinations of food is due to the action of these currents of electricity upon the sense of taste."

A southern correspondent reports the following conversation, which occured between a telephone man and a subscriber. The telephone man was re-charging the subscriber's battery.

The subscriber remarked: "I've just found out what that jar of water is for."

Telephone man: "And what is it for?"

Subscriber: "Why, it's the lightning arrester. You see, the lightning runs down the wire here, and from there into the jar, where the water puts it out."

If you are residing for the Summer months in a town where there ought to be an electric railway, and there is none, a pleasant way to spend the precious hours, when you have returned from business to enjoy the rest and quiet, is to sit on the piazza with other Summer boarders, and divulge large schemes for obtaining electric railway franchises, consent of property owners and rights of way, and then to go down to the village store and discover the rather important fact that for the last three years every batch of Summer boarders has discussed the same thing, and that two applications for franchises have been granted and that the two embryonic companies are fighting for the above-mentioned rights of way and consent of property owners. Next to fighting No. 7 Jersey mosquitoes, this is one of the most pleasant ways of getting the worth of your Summer board.

A party of civil engineers in the West were running a survey line for an electric railway. A farmer walked up to a rail fence, placed his elbows upon the top rail, squirted a powerful stream of tobacco juice, and remarked in a familiar tone: "Say, are you fellers just practicin', or are you doin' that fer money?"

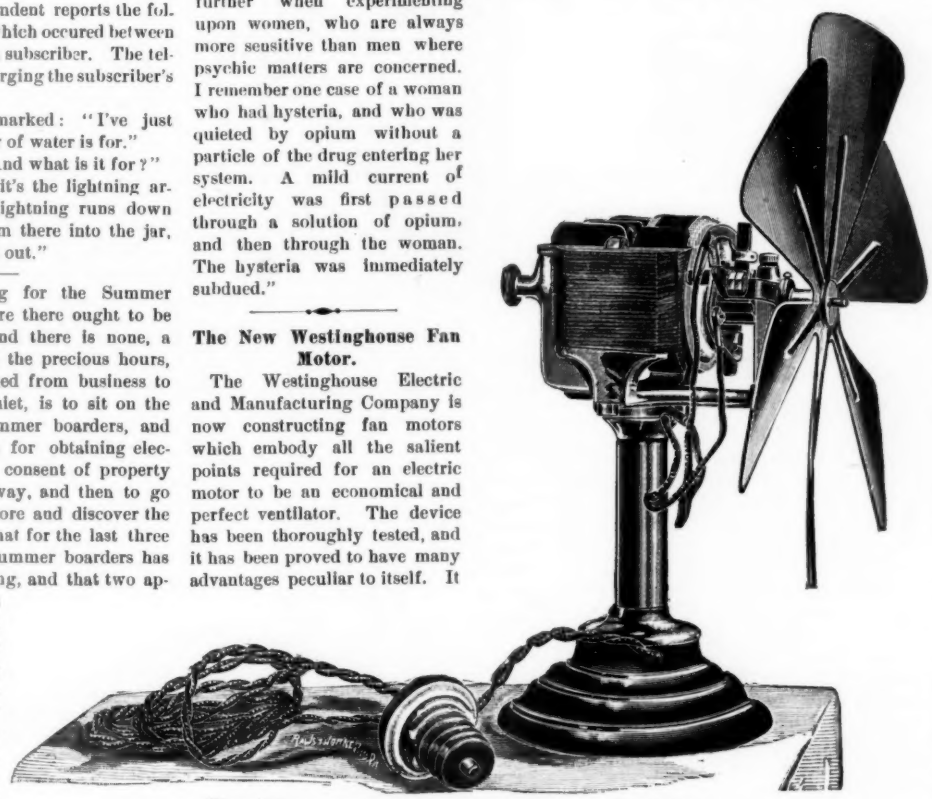
In accordance with a new city ordinance, all hydraulic elevators in Kalamazoo, Mich., have been ordered stopped. Here is a chance to sell an electric elevator or two.

Woo Dan, a Chinaman, has sued a Seattle, Wash., electric railway company for $25,000 damages for the loss of a leg. "The Chinese must go"—even under the street cars.

"Did you ever hear of Dr. James Rodes Buchanan, of Boston?" inquired an acquaintance. "He is the man who has made a life study of psychometry, which is the science of the duration of psychic processes. Sounds like I was working up to theosophy, doesn't it? I'm not though, as you will see. Dr. Buchanan backs up his assertions with tests and experiments of the most practical character. He will wrap in paper a small quantity of any common drug, and place it in the hand of a patient, directing him to hold it for a short time. The patient, although he does not know what drug he has in his hand, is sometimes able to tell what it is, and experiences the same sensations and reaction as if the drug had been taken internally. Dr. Buchanan goes still further when experimenting upon women, who are always more sensitive than men where psychic matters are concerned. I remember one case of a woman who had hysteria, and who was quieted by opium without a particle of the drug entering her system. A mild current of electricity was first passed through a solution of opium, and then through the woman. The hysteria was immediately subdued."

The New Westinghouse Fan Motor.

The Westinghouse Electric and Manufacturing Company is now constructing fan motors which embody all the salient points required for an electric motor to be an economical and perfect ventilator. The device has been thoroughly tested, and it has been proved to have many advantages peculiar to itself. It can be successfully used on an alternating current incandescent circuit. Attached to any ordinary lamp socket, it will not use more current than one lamp. This is a point in its favor which will be readily appreciated by the private consumer, who pays for the electric current according to the amount registered by the meter.



NEW WESTINGHOUSE ALTERNATING CURRENT FAN MOTOR.

One of the motors was placed in one of the company's offices last November, where it has been running without interruption for six months. During all this time it has required no attention whatever, not even the application of a lubricant being necessary.

The armature coils and the wires leading from the armature to the commutator are completely imbedded in a cementing material. This method of imbedding the delicate parts of the armature precludes all danger of short-circuiting it, and obviates any breaking of the wires by rough handling.

The speed of the Westinghouse fan motor can be varied in a manner so simple that even a child may be entrusted with doing it. The motor has two carbon brushes which are set up so as to work automatically; they need not be renewed for years. A moving of these brushes to the left or the right causes the armature either to revolve fast or slowly.

Apart from the usefulness of this little apparatus, it is highly ornamental. The fan is nickel-plated, and the stand on which it is mounted is of brass. The fan motor can be carried about to any part of the room, as it only weighs about nine pounds.

Electric Wire Coupling.

To contribute to the convenience of wiremen and facilitate their work in enabling them to quickly and satisfactorily connect wires, a new wire coupling has been introduced recently to the electrical trade.

The Rhode Island Telephone and Electric Company, No. 13 Mason street, Providence, R. I., has placed on the market Burt & Tobey's electric wire coupling.

The accompanying illustrations show

coupling for both straight and T joints. They are made of brass and copper, tinned for convenient soldering; are simple, durable and cheap. They can be adjusted to the wire with ease, by the aid of a pair of ordinary bell-hanger's pliers and fluid lamp, making a neat and smooth joint and not materially increasing the size of the wire.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

HOLDS ITS EIGHTH ANNUAL MEETING, ELECTION OF OFFICERS AND GENERAL MEETING IN NEW YORK CITY.—A LARGE ATTENDANCE.—MANY PROMINENT VISITORS.

The eighth annual meeting and election of officers of the American Institute of Electrical Engineers was held Tuesday, May 19, at 8 P. M., in the house of the Society of Mechanical Engineers, 12 West Thirty-first street, New York, where the headquarters of the Institute are located. A large and representative meeting took place, and the following officers were elected for the ensuing year: Prof. Alexander Graham Bell, president, to succeed Prof. William A. Anthony; vice-presidents, T. D. Lockwood, Carl Hering, O. T. Crosby, W. J. Hammer; council, Dr. Louis Bell, Herbert Laws Webb, Prof. A. G. Compton, J. Hamblet; treasurer, George M. Phelps; secretary, Ralph W. Pope. The following officers hold over from last year: Vice-presidents, Francis B. Crocker, Frank J. Sprague, Joseph Wetzler; council, Dr. F. B. Herzog, Dr. William E. Geyer, H. C. Townsend, Francis R. Upton, J. C. Chamberlain, P. B. Delany, Horatio A. Foster, H. Ward Leonard.

Professor Bell was not present, but was represented by Mr. T. D. Lockwood, the well known telephone pioneer.

After the meeting adjourned a number of members visited and inspected the Twenty-sixth station of the Edison Illuminating Company.

The first session of the general meeting was called to order at 10 o'clock Wednesday morning by President Anthony. Prof. Francis B. Crocker read a paper on "The Perfection of Stationary Electric Motors." A long and most interesting discussion followed. At noon a recess was taken to enjoy a lunch spread at the Institute headquarters.

At the afternoon session, which was presided over by Mr. W. J. Hammer, Prof. Edward L. Nichols' paper on "A Photographic Study of the Electric Arc" was read. Then followed Mr. Carl Hering's paper on "A New Graphical Method of Calculating Leads for Wiring." This session closed with Dr. F. A. C. Perrine's address on "The Practical Aspects of Electric Welding."

One of the most instructive and important sessions was that of Wednesday evening, held in Professor Dwights' room, at Columbia College. Mr. Nikola Tesla lectured on "Experiments with Alternating Currents of High Frequency," accompanied by practical demonstrations of the most interesting character. No discussion ensued at the close of Mr. Tesla's lecture, owing to the late hour at which he finished.

Thursday morning a number of the members assembled at the Crocker-Wheeler Electric Motor Company's factory, Fourteenth and Washington streets, and were shown through the various shops. At 11 o'clock the regular session was began at the Institute headquarters with Mr. T. D. Lockwood in the chair. Prof. E. L. Nichols read Prof. George S. Moler's paper

on "A New Potentiometer." Then came Mr. Frank J. Sprague's address on "Considerations Which Should Govern the Selection of a Rapid Transit System." The discussion was participated in by Mr. C. O. Mailloux and Prof. George Forbes, of London. Mr. George W. Walker then read his paper on "Electric Meters," after which the session adjourned for lunch, served by Steward Stadler, of the Electric Club.

The afternoon session, presided over by Prof. F. B. Crocker, began with the discussion of Mr. Walker's paper, which occupied some time. Then Mr. M. E. Thompson read his paper on "A Study of an Open Coil Arc Dynamo." After this came Dr. W. H. Wahl's paper on "The Aluminum Problem—Retrospective and Prospective." A discussion followed in which Professor Crocker, Professor Elihu Thomson, Dr. P. H. Van der Weyde and Dr. Leonard Waldo, took part. Mr. Oberlin Smith closed the session and the general meeting with his adddress, entitled, "Shall Aluminum be Alium?"

An interesting exhibition of aluminum products was shown in the hall Thursday afternoon. The exhibitors were the Aluminum Brass & Bronze Company, the Pittsburgh Reduction Company and the Cowles Electric Smelting & Aluminum Company.

All visitors and members were asked to register at the Institute headquarters. Among the more prominent were the following: Elihu Thomson, H. A. Foster, T. D. Lockwood, P. B. Delany, Wm. Maver, T. C. Martin, F. L. Pope, Wm. A. Anthony, Geo. B. Prescott, Jr., C. O. Mailloux, F. B. Crocker, F. R. Upton, Geo. M. Phelps, F. A. C. Perrine, W. J. Hammer, H. Ward Leonard, Edw. L. Nichols, Chas. S. Bradley, P. H. Van der Weyde, Carl Hering, P. H. Alexander, Harold Binney, Dr. Otto A. Moses, Osborn P. Loomis, R. Varley, Jr., Edward Weston, Elmer A. Sperry, Edw. Rice, Jr., Oberlin Smith, Frederick Reckenzaun, Dr. Leonard Waldo.

Detroit Electrical Interests.

A recent investigation of the *status* of all the various electrical concerns of Detroit, Mich., showed that there was $4,151,300 invested in plants, with gross earnings footing up $2,547,301. The number of hands employed in this branch of industry is 1,719, with an annual pay roll of $724,210. These figures can now with safety be increased at least 10 per cent., says a local paper.

A New Chicago Supply House.

The Edison General Electric Company has leased the premises 171 and 173 Adams street, Chicago, at a rental of $150,000 for a term of 10 years. The property has a frontage of 50 feet on Adams street and is 175 feet deep. The building is a modern structure, six stories and basement high. The improvements to be made on it will exceed $25,000. The Edison Company's occupancy of the premises will commence July 1. The ground floor will be used as a salesroom, while the upper floors will be used as warerooms for electrical supplies.

The Perfection Desk Clamp for Incandescent Lights.

A great convenience for the business man who uses an incandescent lamp to light his desk is shown in the illustrations on this page. It is a clamp attached at right angles to the socket of the lamp and adjusted to be used on the shelf of a pigeon-hole of a desk or any similar place. In the end of the clamp is a hole so that the light may be hung on a nail if desired. A lamp is shown in this position in Fig. 1.

The shade is made of aluminium and acts as a reflector. In Fig. 2 the clamp is shown applied to a music rest or copy-holder for the use of stenographers; this, it will be seen, is fitted with the well known McCreary shade. The same combination is shown in Fig. 3, where the lamp is used as a drop light.

Mr. J. B. Moore, of Minneapolis, is the patentee and manufacturer of this device.

Reception at the Electric Club.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS ENTERTAINED BY THE MEMBERS OF THE ELECTRIC CLUB, AT THEIR HOME ON TWENTY-SECOND STREET.

The annual meeting of the American Institute of Electrical Engineers closed most auspiciously and pleasantly by a reception tendered to it by the Electric Club, of New York, Thursday evening of last week. Every room in the Club House was brilliantly lighted, and hundreds of prominent electricians, many from distant cities, were present. Among those present were Prof. Elihu Thomson and Prof. E. W. Rice, Jr., Lynn, Mass.; Prof. William A. Anthony, Manchester, Conn.; Prof. George Forbes, London, England; Edward Weston, Newark, N. J.; W. T. Beidler, Baltimore, Md.; Thomas D. Lockwood, Boston, Mass.; Hiram Maxim, the widely known inventor; Franklin L. Pope, Nikola Tesla, William Stanley, Jr., Francis R. Upton, J. E. Emery, William J. Hammer, besides probably 200 other members of the Club and Institute.

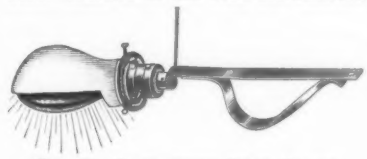


FIG. 3.—PERFECTION DESK CLAMP.

FIG. 2.—PERFECTION DESK CLAMP.

The feature of the evening was the very interesting historical collection of electrical literature and electrical appliances arranged on the second floor. Mr. T. C. Martin, of the entertainment committee, who planned and arranged for this remarkably interesting collection, is to be most highly complimented for his success, and is deserving of the thanks of every member of the Club and Institute for the excellent arrangement and clear presentation of the different elements of the exhibit. The list published below will give our readers an excellent idea of what was to be seen, and who the gentlemen were who kindly loaned the various collections for the occasion. An excellent collation was served, which, of course, presented the Club's famous punch bowl in full usefulness.

After 11 o'clock, President Insull, of the Club, spoke a few kindly words of welcome on behalf of the Club to the visiting electrical engineers, which were received with much applause.

Edward Weston, a past president of the American Institute of Electrical Engineers, responded on behalf of his Association in a very happy address, in which was predicted the further advancement, each in its own particular field, but yet in parallel and friendly lines, of both the Electric Club and the American Institute of Electrical Engineers. Mr. Weston alluded very interestingly to the early work of the pioneers in any art or science.

Mr. Joseph Howard, Jr., the widely known war correspondent and journalist, was called out as the representative of a profession to which all arts, sciences and industries were greatly indebted, and responded in a very witty manner, expressing his appreciation of the work that was being done by the scientists and artisans of the day, and flattering the electrical gentlemen present by classing them among the millionaires of the present and the future.

Prof. George Forbes, of London, Eng., spoke briefly of the pleasure he always had in meeting with the electrical people of America, and especially under the hospitable roof of the Electric Club, and humorously sounded a warning note against too much satisfaction with our present accomplishments, by calling attention to the fact that he had read a book, among Mr. Benjamin's collection up stairs, dated some time in the year 1600, in which the author had severely criticized the ignorance of the scientists of the earlier days, and congratulated himself and other scientists on the fact that at last they had discovered all about electricity. This sally was greeted with much laughter.

Mr. T. C. Martin, on behalf of the entertainment committee, stated that Mr. Hiram Maxim had kindly consented to deliver an address to the Electric Club, Thursday evening, of this week. The announcement was received with applause, and President Insull stated that the members of the American Institute were invited to attend. The formal proceedings were declared at an end, but the

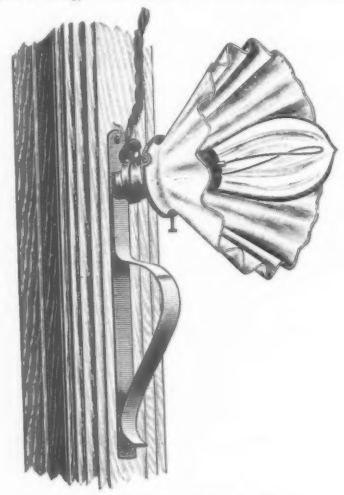


FIG. 1.—PERFECTION DESK CLAMP.

pleasant gathering did not separate until a much later hour.

ELECTRICAL EXHIBITION AT THE ELECTRIC CLUB.

Probably the most complete historical electrical exhibition ever attempted was thrown open at the Electric Club, Thursday evening, May 21. The whole of the second floor of the Club house was devoted to it. Here the exhibits were most tastefully and conveniently arranged by Mr. T. C. Martin, to whom great credit is due.

Hung on the walls were several collections of valuable autographs and historical portraits, some of them almost priceless.

Prof. Edward Weston's collection included a portrait and autograph letter of each of the following noted men: Darwin, Tyndall, Priestly, Sir Humphry Davy, Faraday, Herschel, Humboldt and David Hume.

Prof. A. B. Chandler also loaned a large collection of autographs. Some of the representative ones were: Thos. A. Edison, who wrote to Professor Chandler, in 1883 for "a first class foreman of construction. Want a pusher who has brains, who wears an 8⅜ hat and reads Plato in the original Greek." It would be interesting to know who secured the position. Professor Morse's salutation to the Japanese Embassy, 1872. Autograph note of P. T. Barnum. A Bain telegraph record, 1856. A number of State papers obtained by Professor Chandler when he was a member of the Military Telegraph Corps.

Mr. T. C. Martin exhibited several relics of Morse, including autograph letters and sketches of apparatus.

Herbert Laws Webb loaned an early print illustrative of submarine cable work.

An autograph letter of Prof. Joseph Henry, presented to the Electric Club by Mr. W. D. Sargent, was shown.

Scribner's Magazine loaned several oil paintings showing various steps in submarine cable laying.

Mr. Park Benjamin loaned a copy of a contemporary portrait of Boyle, made by Mr. Benjamin, and a large collection of interesting and very valuable electrical books, arranged in sections as follows: "The Dawn of Electricity;" "The Conflict of Superstition and Science;" "The Pioneer Days of Static Electricity;" "The Period of Franklin;" "The Period of Galvani and Volta;" "The Beginnings of the Electro-Magnet;" "The Development of Electrical Industries;" "Miscellany of Rare Books."

The University of the City of New York sent for exhibition the remains of the Morse battery, "which in this University sent the first telegraphic message by the hand of Prof. Samuel F. B. Morse." These fragments are all that remains of the original apparatus used in the investigations of Professors Morse and Gale, and Mr. Vail.

The original electric railway and motor of Thomas Davenport was exhibited by the *Electrical Engineer*.

Mr. L. Stieringer exhibited a case of antiquities showing the earliest incandescent lamp key sockets, and the first chandelier wired and arranged for the incandescent light. It was used at the residence of Mr. Francis R. Upton, in Menlo Park, 1880, and was presented by him to Mr. Stieringer.

An alternating current transformer, made and operated by Mr. Edison, at Menlo Park, in 1878, was shown.

An original transformer and photograph of an alternator used for parallel distribution of alternating currents, was loaned by Mr. Wm. Stanley, Jr.

Two examples of the earliest English single-needle telegraph instruments were exhibited by the Electric Club, to whom they were presented by Mr. C. H. Haskins.

A large collection showing the evolution of the incandescent lamp socket was loaned by Mr. E. F. Gennert.

Mr. W. J. Hammer's collection was one of the largest and most varied in the exhibition. Mr. Hammer possesses what is, undoubtedly, the most complete collection of incandescent lamps in existence.

The art of lamp making can be traced through this collection step by step. About a fifth of the number in Mr. Hammer's possession were shown. Several photographs of Edison's first laboratory at Menlo Park, 1880, formed a part of this exhibit; a photograph of the first electric railway; an oil painting of the ideal Goddess of Electricity; samples of the experimental filaments used in the first Edison lamps; the plug which closed the circuit lighting the first incandescent lamp in the first central station in the world; a collection of autograph photographs of the leading electrical inventors; a photograph showing the first isolated Edison plant, that installed at the Crystal Palace, London, in 1881–2, were interesting features of Mr. Hammer's exhibit. Those who missed this exhibition have much to regret. Its like will probably not be seen again until the World's Fair or until the American Institute of Electrical Engineers and the Electric Club possess historical electrical museums.

A Fine Order.

The entire order for the overhead electrical equipment, including rail bonds and poles, for the 40 miles of electric road in Memphis, Tenn., has been awarded to the Electric Merchandise Company, of Chicago. As it was necessary for all such material to have the approval of the electric company putting in the apparatus, this may be considered a very strong endorsement of the line material of this company's manufacture.

A gentleman interested in electrical matters writes from Pittsburgh as follows: "The sentiment here with regard to the Westinghouse Company is very favorable and everybody seems encouraged and hopeful. I rode on the electric car run by the new Westinghouse motor—gearless, noiseless, iron-clad. There is absolutely no noise, apparently less than in the ordinary horse car; no jolting or shaking, runs smoothly around the curves and up the hill in Allegheny as easily as could be wished. I understand that they have already some 200 orders for the latest equipment."

A Communication from Prof. Moses G. Farmer on Bi-Metallic Conductors.

To the Editor of Electrical Review:

It is really refreshing to one's craniological development to read, on page 162 of your issue of to-day, that: "An entirely novel proposal has recently been made by a French engineer—M. Edouard Martin—which, it is alleged, is likely to become rapidly and widely adopted, since it refers to a really practical solution of the problem of wire conductors, and is not merely 'another new scientific nostrom.' * * *

"The electrical conductivity of the compound wire referred to that of pure copper has been determined to be about 60 per cent."

A certain Dr. Laisant, "who has made careful experiments with these bi-metallic conductors, states, that to enable a copper wire to stand all the ordinary strains which it is likely to meet with when in use, a minimum diameter of 2.5 millimetres would be necessary. Such a thickness would mean a weight of 43,700 kilogrammes per kilometre, and it would cost, according to the present price of copper, say, 91.75 francs per kilometre. On the other hand, a bi-metallic wire, made according to M. Martin's idea, need only be 1.9 millimetre in diameter in order to possess sufficient conductivity and strength for ordinary telephonic purposes, yet it would weigh only 25.35 kilogrammes per kilometre, and would cost only 48.15 francs per kilometre.

"These wires are being manufactured on a commercial scale by a patented process by M. Martin, at his works at Joinville-le-Pont, where specimens are drawn, varying in diameter from a tenth of a millimetre to upwards of a centimetre, the proportion of the iron and steel being determined by the value of the conductivity required for any given purpose.

"One might, therefore, naturally suppose that when the bi-metallic conductors are subjected to varying temperatures, some disturbance would arise owing to the inequality of the expansion of copper and steel. No doubt some action does take place, but in actual practice, which is the important consideration, no disadvantages have been found to arise."

Now it is quite evident that M. Martin, also Dr. Laisant, "do live in from the road, and do not take the papers," else they ought to know that, on May 30, 1865 (26 years ago), the United States patent office granted and issued a patent to Moses G. Farmer and George F. Millekin for "a copper conductor having a core or covering of iron or steel."

Neither do they seem to know that a half mile of such compound or bi-metallic wire was made in New York by the electro-deposition of copper upon steel in 1868, using a current of electricity derived from a thermo-electric battery, which weighed about three-quarters of a ton, and which employed 3,744 pairs, connected up 12 pairs in series, by 312 pairs in multiple, the whole battery having an internal resistance of little over two one-thousandths of an ohm, and manifesting a difference of potential of three-tenths of a volt at its terminals, said battery being heated by hard coal, which is consumed at the rate of 109 pounds in 24 hours, and in this time deposited 12 pounds of copper on the half mile of wire.

Neither do they seem to be aware that an ingenious machine was invented and patented by Mr. Alanson Cary, of New York, which would draw a skelp or covering of pure copper upon and over a steel wire, which had been tinned superficially to prevent its rusting and to aid in soldering the copper to the steel. Nor do they seem to be aware that, by the use of these machines, many hundreds—yea, thousands of miles of wire of this kind were made, put up and used; that one of these wires was erected between Washington and New York, and that 252 words per minute were sent over this wire from Washington to New York, in 1870, by the undersigned, using the automatic telegraph, and that more than 500 words per minute could have been sent in the same time had it been possible to run the machines fast enough. Neither do they seem to be aware that a line of telegraph was erected in New Hampshire, in length more than 25 miles, which is still in use, never having been broken by the wildest sleet storm which has visited this region in all these long years.

Messrs. Martin and Laisant seem not to be aware that a wire, which was over five-eighths of a mile in length, was stretched across the Mississippi River in 1870, and that it did good service for many months.

Also a wire of over 1,200 feet in length did service at the Dudley Observatory for a long time.

They do not seem to know that in the early eighties many miles of compound, or if you like it better, bi-metallic wire, were manufactured by the Postal Telegraph Company, working under the patent of the late Luther L. Smith, the most accomplished and skillful worker in electrolysis which this country has ever seen.

Messrs. Martin and Laisant seem not to be aware that about 1,000 miles of this electrolytically deposited wire of sufficient size to offer only one and a half ohms per mile of resistance, were erected between New York and Chicago some dozen years ago, and that communication by telephone was held by means of this wire between the two cities, it being the farthest distance apart of any two telephonic stations hitherto connected through which conversation could be heard.

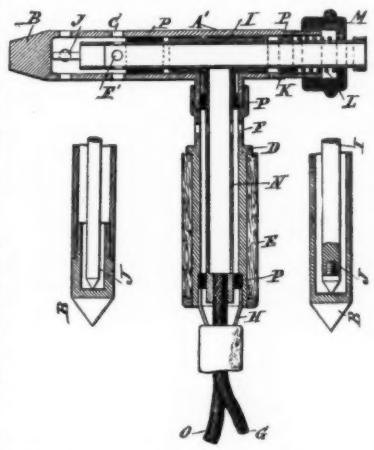
The compound or bi-metallic wire is yet to fill a place in the telephonic and telegraphic world, because a proper combination of two metals, one having the greatest conductivity, the other the greatest strength, is the coming man who can shake his fist in the face of the wildest sleet storm and say, "Do your worst, I am ready."

Moses G. Farmer.

Eliot, Me., May 16, 1891.

Electric Heating.

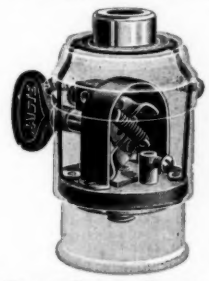
One of the many industrial uses to which electricity is put is the heating of soldering tools. The facility with which the heat can be localized when developed electrically marks it as the pre eminent agency for such a use, and when the distribution of current becomes general, it will monopolize the field for such purposes. In a patent recently granted to Charles Zipernowsky is described a system of heating by variable contact. The invention is described with particular reference to soldering tools, but may, of course, be applied to any other purpose. Heat is ordinarily developed electrically by interposing a conductor of considerable resistance in the path of the current, such as a high resistance wire or a pulverulent conductor. Mr. Zipernowsky, however, brings two conductors into contact, and by varying the pressure at the point of contact regulates the amount of heat developed. In the accompanying illustration is illustrated a soldering iron constructed on this principle. The leading-in wires O, G, are connected to metallic tubes insulated from each other by asbestus or some other suitable material, and these tubes are connected electrically with an outer metallic shell A^1 and a concentric



tube I. The tube I is held by the pressure of a spring L in contact with a solid metallic tip B on the outer tube. The tension of the spring may be regulated by the adjustment of the ring M. A pin J, provided with a tapering tip, is connected with the inner tube. The point of the tip bears against the head B. When the device is interposed in an electric circuit current passes through the contact formed between the pointed tip and the head B, which has sufficient resistance to develop heat. A firmer or lighter contact, produced by adjusting the ring M, develops a lower or higher heat. Openings are made in the tubes for the purpose of ventilation, so as to prevent overheating of the handle of the tool, and confining the heat to the soldering point B. The pin J and head B may be removable, as shown in the detached views, for the purpose of renewal after long continued use.

The Paiste Switch Socket.

Many electricians have desired a socket that would carry and break five amperes, but heretofore this want has never been catered to by electrical manufacturers. Mr. Paiste set to work and placed his well known five ampere switch in a socket to make and break the circuit. His first attempt was not as satisfactory as he desired, the socket being made too large and unhandy to wire up. In the new style, which is just now being introduced, the socket shell is greatly reduced in size, making it the smallest socket on the market. Great care and attention was given to the manner of connecting the wires. By an ingenious device the wireman can use his discretion between a binding



Paiste Switch Socket.

post and a binding screw. When in the act of wiring, both shells can be removed from the socket, leaving a clear, unobstructed place to work. By means of a yoke and collar the socket can be securely fixed to a chandelier, and under no circumstances can the shell short circuit the wires. All insulating parts are made of Syracuse china, insuring a perfect insulation. Central station men should appreciate this socket, as by its use, one can, during the Christmas holidays, substitute large candle-power lamps for the normal ones, without fear of destroying the working parts of the socket. Although not a cheap socket to make, through the agency of special machinery, it is offered in competition with those now on the market.

Telegraph Extension Under Difficulties.

The successful extension of the telegraph line from Yunnan to Momein, on the borders of Burmah, has led to the suggestion that the officers engaged in the work shall receive rewards on the same scale as is accorded in practice for the safe transmission of urgent messages from the field of battle. How well such awards are deserved is shown by the accounts of the conditions under which this arduous enterprise was carried out. The distance from Yunnan to Momein is 530 miles, and the route lies through a mountainous and densely wooded country, where frequently no trace of habitation occurs for over 30 miles. The work of construction was carried on by day under a blazing sun, which caused intense thirst, while by night the men were obliged to camp out in the open air, and had to be constantly on their guard against the attacks of wolves and tigers. Three treacherous and turbulent rivers, each of which was in fever-stricken localities, had to be crossed. The waters of one of these rivers, the Salveen, are muddy and unwholesome, and are said to be so deadly that the feet of men and hoofs of horses rot and drop off from contact with them. The officers and men of the expedition crossed the river on rafts constructed of wire reels, and reached the opposite bank only after a hard struggle. The malaria was most virulent, and no fewer than 10 members of the party succumbed to its effects during the three days occupied in carrying the telegraph line across the river. To push through to successful termination such an expedition as this requires more than ordinary bravery, as well as prodigious energy, and it is only just that the conquests of peace should receive as full recognition as those of war.

New Subway Work.

The privilege of building subways for low tension wires and the control of those subways already put down for the wires of local telegraph and telephone companies, has been awarded by the New York Board of Electrical Control to the Empire City Subway Company, Limited.

Salina, Kan.—The Salina Electric Railway Company; capital, $100,000.

Monticello, Ill.—The Monticello Electric Light Company; capital, $10,000.

Hagerstown, Md.—Hagerstown Heat and Light Company; capital, $35,000.

Great Falls, Mont.—American District Telegraph Company; capital, $30,000.

Cincinnati, O.—The Ohio Telephone and Telegraph Company; capital, $25,000.

Clayton, Del.—The Clayton Water, Light and Power Company; capital, $50,000.

St. Louis, Mo.—St. Louis Electric Railway and Power Company; capital, $50,000.

Greenville, Pa.—The People's Electric Light, Heat and Power Company; capital, $25,000.

St. Paul, Minn. — Carpenter Electric Heating Manufacturing Company; capital, $400,000.

Butte, Mont.—The Citizens' District Messenger and Burglar Alarm Telegraph Company; capital, $6,000.

Cleveland, O.—The W. D. Graves Electrical and Manufacturing Company, Cleveland. Capital, $25,000.

Cornwall, Va.—The Cornwall Building Company; real estate, conducting, gas and electric light plants; capital, $100,000.

Noblesville, Ind.—The Noblesville Water and Light Company; capital, $50,000. Directors, James R. Christian, Walter N. Evans, William T. Johns, John C. Craig, Elbert M. Hare, Ira W. Christian and Theodore P. Davis.

Saco, Me.—The Whitney Electrical Investment Company; capital, $500,000; for the purpose of manufacturing electrical apparatus. The officers are: President, James F. Preston, of Lowell, Mass.; treasurer, George B. Watson, of Boston, Mass.

Peoria, Ill.—The Municipal Construction Company; to build and operate water works, electric light plants, street car lines, sewers and drains, etc.; capital, $100,000. Incorporators, Samuel B. Hartz, John F. King, George H. Lucas and others.

Lakeport, Cal.—The Highlands Springs and Squaw Rock Toll Road Company; capital, $15,000. The company is to operate a toll road, telephone and telegraph lines between the above named places. Estimated length of road and lines 12 miles.

Mr. Leonard Makes Some Corrections.

To the Editor of Electrical Review:

I find certain errors in the table of formulæ accompanying my paper read at Montreal (see Electrical Review, May 23, 1891), which errors are typographical ones and made at this office. Will you kindly make the following corrections?

In the formulæ for power at motor pulley which is

$$M = \frac{D \times h.\ p. \times 1600}{V \times e \times P}$$

the number 1,600 in the numerator should be 16,000.

In the formulæ of weights for any case, which is

$$T = \frac{C \times D^2}{V \times 746.0}$$

the decimal point following the 6 should be struck out.

In the definition of G, read "delivered *to* conductor," instead of "delivered *by* conductor." Yours, very truly,

H. Ward Leonard.

New York, May 18, 1891.

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NEW YORK, MAY 30, 1891.

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You will find it worth while to carefully read in this issue of the REVIEW, the papers read before the American Institute of Electrical Engineers. A more interesting and instructive collection of addresses was never printed.

Prof. Moses G. Farmer, in a communication on another page of this issue, relates some interesting historical facts regarding bi-metallic conductors. Prof. Farmer expresses his faith in the utility of compound conductors.

It is not surprising, but at the same time a matter for congratulation, that the New York Rapid Transit Commission is reported to have decided upon electric power as the means to the desired end—quick, safe and clean transportation for New York's busy people.

The projected electric railway has caused values to jump on the Ridge road. Farmers now hold their property at $200 per acre.—*Buffalo Times.*

In spite of the fact that this proposed road is in an intensely embryonic state, the usual effect of an electric railway upon real estate values is noticed at once.

In the *New England Magazine* for June will be found "The First Line of Electrical Telegraph," by Stephen Vail, a son of Alfred Vail, whose name is familiar to all interested in the electric telegraph. It is a very interesting and comprehensive account of the early experiments and successes in which his father took a considerable share. The article is well illustrated, and contains a fine portrait of Alfred Vail from an old daguerrotype, now very scarce.

An interesting departure in New York journalism is the brilliant daily reviews of the news of the day which appear in the *Evening Sun* over the initials "A. B." These first letters of the alphabet evidently stand for Arthur Brisbane, the accomplished young managing editor of that paper. His reviews are instructive, graceful and piquant, and mark their author as a writer who has seen a thing or two, and rubbed up against human nature in many parts of this little earth of ours.

Judge Wallace, of the United States Circuit Court, will this week try the suit of the Edison Electric Light Company against the United States Electric Lighting Company. The suit is brought on United States patent No. 223,898, granted to Thomas A. Edison in 1880 for improvements in incandescent electric lamps. The patent involves what Mr. Edison asserts was the fundamental invention relating to incandescent lighting which made that method commercially practicable, and is a very important one.

Electrical men in Chicago are still battling with the directors of the World's Fair for proper treatment for the electrical exhibit. So far the odds seem to be in favor of the original and defective plans being persisted in, despite the protests of electrical men throughout the country. Not only the electrical press generally but many of the daily newspapers of Chicago unite in condemning the obstinate attitude of the directors of the Fair. If their policy is carried out the electrical exhibit will disappoint the expectations of a very large section of the community, but at any rate it will be perfectly clear that the responsibility for any failure will rest with the directors of the exhibition and with them alone.

SOME NEW POINTS IN RELATION TO GOVERNMENT CONTROL OF THE TELEGRAPH.

Out in Cincinnati, last week, a lot of enthusiastic men and women convened to form a new political party. They called it the People's Party and adopted a platform, one plank of which was government ownership of telegraphs and railroads. To fortify their own notions in the matter, a number of the leading spirits went over into Kentucky to consult Senator John G. Carlisle, an honest, broadchested man, and get his approbation of their platform. Government ownership of railroads and telegraphs was brought up and Mr. Carlisle turned questioner. The New York *Sun* thus reports the conversation which ensued:

"Do you propose to get possession of these properties by confiscation?" he asked them.

"No, that wouldn't be fair," they admitted.

"Then you must buy them," was the reply, "and to buy them you must pay for them, and to pay for them you must tax yourselves. Have you any idea how much it would cost? Our government debt at the close of the war was more than two thousand millions, and we have been almost 30 years in paying half of it. The railroads, telegraphs, telephone lines and steamboats in the country represent about $10,000,000,000 invested capital; $4,000,000,000 is bonded indebtedness which must be paid. Are you ready to tax yourself to raise this money? Then, after you have got the property, are you ready to tax yourselves to operate it, for the government never yet succeeded in doing business at a profit? Consider another effect; such a plan would add perhaps 1,200,000 men and woman to the roll of government employés. How would you ever succeed in turning out of power an administration with such resources at its command? The more corrupt it was the more difficult it would be to displace it."

The delegation looked dubious and perplexed, for the questions and suggestions were evidently all new to their sanguine and enthusiastic minds.

ELECTRICAL ENGINEERS' ANNUAL MEETING.

The annual meeting of the American Institute of Electrical Engineers held in this city last week, was the most suggestive and prophetic gathering in the history of that growing and influential organization. An unusually large number of the brilliant men in the profession lent their presence to the occasion. Every session was well attended by earnest, faithful workers in the vineyard of electrical science, and the addresses and lectures were of an unusually high order of merit, even for such a scientific body as the Institute.

The reception at the Electric Club at the close of the meeting can result in nothing less than a firm cementing of the fraternal bond which legitimately exists between the Institute and the Club. Let us hope that soon the annual meetings of the Electrical Engineers may be held in a home owned conjointly by them and the members of the Electric Club.

SUBSTITUTE FOR PLATINUM IN INCANDESCENT LAMPS.

It is well known that the leading-in wires of electric incandescent lamps should have the same or nearly the same co-efficient of expansion and contraction as the glass into which they are sealed, because otherwise the glass on cooling, after being sealed to the wires, would separate therefrom and an opening be made which would permit air to enter the bulb and destroy the carbon conductor For this reason platinum has been universally used for this purpose, other well known metals suitable for use as electrical conductors—such as silver and copper—having too great a co-efficient of expansion or melting at too low a temperature for this particular use. The co-efficient of expansion of glass is 91, while that of platinum is 98. Mr. R. A. Fessenden, of Roseville, N. J., claims that silicon alloyed with iron, nickel, cobalt, manganese, silver or gold, in certain proportions, produces a conductor which has the same co-efficient of expansion as glass and may, therefore, be used as a substitute for platinum for leading-in wires. Silicon being much cheaper than platinum, the alloys are still cheaper. As the alloying metals all have a greater co-efficient and silicon a lower one (78) the proportions may be made such, it is claimed, that the alloy has exactly the same co-efficient.

In a recent editorial we discussed the question of the best transmitter to be employed for the London-Paris telephone line, about which the English and French authorities are not yet of the same opinion. A correspondent takes exception to the suggestion we then made that a pair of American Bell long-distance transmitters would give greater satisfaction than any other form of instrument. Our correspondent draws attention to the fact that that form of transmitter is really the Hunnings, which was invented in England. There is unquestionably an error here, as although in the transmitter in question the principle of the Hunnings invention has been adopted yet the fact remains that the construction of the instrument—to which its great efficiency is due—was developed, after many trials and experiments, in the laboratory of the American Bell Company, which at that time was in charge of that very capable inventor and expert Mr. E. T. Gilliland. The long-distance transmitter embodies the principle of the Hunnings instrument as regards the use of granular carbon, but there is as much difference between it and the original Hunnings transmitter as made in England as there is between the phonograph of to-day and the tin-foil machine of 12 years ago.

It all came off as the REVIEW said it would. The general meeting of the Institute was a pronounced success; the average quality of the papers read was remarkably high, and the attendance throughout was very good. All who attended Mr. Tesla's brilliant lecture on Wednesday evening will remember that occasion as one of the scientific treats of their lives. Even studious men who follow carefully every advance made in the study of our science must have felt astounded at the strides which Mr. Tesla has made in the comparatively unexplored fields in which he is so able a pioneer. The reception at the Electric Club on Thursday evening was simply beyond all praise. The remarkable exhibit of curious old books and relics must have been a surprise to everyone who inspected it; few would have imagined that such an exhibition could have been got together in such a short space of time and with so few sources to draw upon.

CORRESPONDENCE.

OUR WASHINGTON LETTER.

Prof. Watkins, secretary of the Inventors Association, is making a tour through New England in the interests of the new organization.

The Chesapeake & Potomac Telephone Company is about to issue 5-20 bonds to the amount of $400,000 for the purpose of extending its underground system and erecting a new exchange building in Washington. The building will be located on Fourteenth street just above New York avenue.

The United States Electric Lighting Company has recently enlarged its plant by the addition of one 1,300 light Thomson-Houston alternating current dynamo, to supply West Washington and other points within the city limits more than one mile from the station. This is the first attempt at alternating current lighting from the central station in Washington.

An Electrician Wanted.—After July 1 an electrician will be wanted at the U. S. Naval Observatory at a salary of $1,500 per annum. All applicants will be required to pass a civil service examination, which will be both theoretical and practical, covering the subjects of electric batteries, the measurements of currents and resistances, the construction and maintenance of electric lighting plants, and the methods of transmitting power by electricity. The examination may be taken at any date named in the schedule of the Civil Service Commission, or at the special date which will be fixed as soon as a sufficient number of applications are received.

The State, War, and Navy Department building, which has been lighted by current from the United States Electric Lighting Company's central station, will hereafter be lighted by an isolated plant, consisting of four No. 16 Edison dynamos, driven by two McIntosh & Seymour engines of 125 horse-power each, on which rope belting is used. Steam is supplied by two Towne boilers of 125 horse-power each. The dynamos have a capacity of 720 16 candle-power lamps each, and are arranged in pairs on the three wire system in such manner that they can be readily connected on the two wire system. The plant is in duplicate, one engine driving two dynamos, so that the entire plant or only half of it may be used as necessary. There are at present about 1,000 lights in the building, which number is being increased daily. This plant also furnishes light for the White House, which has about 800 lights. The wiring of the building and the installation of the plant has been done under the supervision of Engineer George W. Baird of the Navy, who has had much experience in electrical matters.

A Meeting of the Executive Council of the American Association of Inventors and Manufacturers was held in Washington on the 9th inst. Dr. R. J. Gatling, president, and Gardiner G. Hubbard, 1st vice-president, of the Association, were among the prominent men present, and measures were taken to put the Association into practical working shape. A committee, of which Prof. R. H. Thurston is chairman, was directed to prepare an address to the public, setting forth the objects of the Association which, as defined by the constitution, are "The promotion of progress in science and the useful arts;" the diffusion of practical, scientific and legal information respecting inventions; the encouragement of favorable and the discouragement of unfavorable laws respecting property in patents; the co-operation of foreign inventors for reciprocal regulations under foreign patent systems; the proper, just and adequate protection of American inventors authorized by the Constitution of the United States. The annual fees are $5, and a payment of $100 constitutes a life member. A committee on promotion, of which Prof. Wm. A. Anthony is the electrical member, was also appointed. A committee, consisting of Prof. J. E. Watkins, Oberlin Smith, Benjamin Butterworth, Charles F. Brush, Dr. Gatling and D. G. Weems, was appointed to represent the Association in matters connected with the World's Columbian Exposition. Gardiner G. Hubbard, Prof. Watkins and M. C. Stone, of Washington, Dr. Gatling, of Hartford, and D. G. Weems, of Baltimore, are the members of an executive committee which will have the immediate control and direction of the affairs of the Association.

G. C. M.

Washington, D. C., May 20, 1891.

OUR BOSTON LETTER.

Mr. Julius Pinney, secretary The Citizens' Gas Light Company of Willimantic, Conn., enjoyed a few days sojourn among his electrical friends in this city.

Correction.—The Redding Electric Company of this city was erroneously reported in last weeks REVIEW, to have removed to No. 161 Franklin street. The company's office is now located at No. 41 Federal street.

Prospective Electric Light and Gas Combine.—Negotiations are pending whereby it is expected that the Willimantic Electric Light Company, will sell out its entire interests to the Citizens' Gas Light Company of Willimantic, Conn.

An Electric Railway for Providence.—After a hard and close fight the street railway company in Providence has gained a victory over the board of alderman of that city. The latter has granted the former permission to use electric propulsion instead or horses on one of its longest railway routes.

Edwin L. Edes, manufacturer of battery zincs, Plymouth, Mass., is enjoying a very large and rapidly increasing business with the electrical trade. The zinc furnished by Mr. Edes is said to be purer and superior to ordinary zinc, and gives thorough satisfaction, particularly for telegraph signal and fire alarm service. Mr. Edes is one of the principal owners in the Edes, Mixter & Heald Zinc Company's mines in Tennessee.

Messrs. Bradford, Kyle & Company, manufacturers of insulated wire, Plymouth, Mass., are attracting unusual interest among the users of insulated wire by succesfully producing a silk covered magnet wire only two-thousandths of an inch in diameter, said to be the smallest covered wire ever made. This firm has two other specialties, *i. e.*, covered aluminum wire and covered German silver wire of very high resistance. On some grades of wire the firm applies an adhesive sub-coating to the wire before covering, thus insuring a covering which cannot slip.

The Atlantic Covering Company, of Plymouth, Mass., although a new enterprise, has already secured a firm footing with the electrical trade of the country. This company has a process for covering wires and cables which insures a campact and uniform coating, and a perfect insulation. The company's factory is adjacent to the depot and near the beach. The machinery equipment is new and contains all the modern improvements and is run by electric power.

Boston, May 23. W. I. B.

OUR CHICAGO LETTER.

A Complete Working Model of the Forsythe Elevated Electric Railway is on exhibition in this city.

J. R. Burdick, representing the H. W. Johns Company, called at the REVIEW's Chicago office this week.

W. A. Sheldon, special agent of the Schuyler Electric Company called at the Chicago office of the REVIEW last week.

Messrs. Bleckert & Nelson, fixture manufacturers, are introducing some handsome designs in combination electric and gas fixtures.

Mr. D. B. Dean, has just returned from a four weeks trip in the interests of his company, the Electric Merchandise Company, 11 Adams street, Chicago. He reports a highly successful trip.

Hood, of 239 La Salle street, is already making some good sales of the new "Jewel" incandescent lamp for which he is general agent. His accumulator business has also taken upon itself a boom within the last 10 days.

The Patton Motor and Manufacturing Company have just purchased a Baxter Motor for their new Patton motor car, which is nearing completion at Pullman, Ill. They speak very highly of the working of the new motor.

The Union Electric Works, recently organized with a capitalization of $50,000, have located in the Springer Building, and are now prepared to manufacture on shortest notice electric motors and specialties generally.

Mr. Geo. H. Meeker, who arrived a few days ago to take charge of the western office of the New York Insulated Wire Company, has been busy this week getting things in running shape. He reports a flattering show of business for the initial week.

Mr. E. E. Keller, formerly manager of the western office of the North American Construction Company, has become identified with the Chicago office of the Fort Wayne Electric Company. Mr. Keller will spend most of his time in this city looking after the city business.

J. A. Rhomberg, president of the Dubuque Street Railway, was in the city this week. The storage battery cars are all in operation now and are giving excellent satisfaction. There are nine cars actually running, and there will shortly be several more. The citizens are in a jubilant state.

The Sunbeam Incandescent Lamp Company have been obliged to still further increase their plant. They are putting in a large dynamo of the Royal Electric Manufacturing Company type, manufactured at Peoria, Ill., and one large Packard vacuum pump.

Atlanta's Loss is Chicago's gain. Dr. John McKinlock, formerly one of Detriot's prominent physicians and at present connected with the Central Electric Company of this city, has just returned from the South bringing with him Mrs. McKinlock, one of Atlanta's most accomplished and beautiful ladies. The wedding occurred on Wednesday evening last. Mrs. McKinlock was a life-long resident of Atlanta and has been for some time one of the bright lights in Atlanta society. They will be at home to their friends after June 1, Hotel Woodruff, Chicago. L. W. C.

Chicago, May 23.

ALTERNATING CURRENTS OF HIGH FREQUENCY.

THE BRILLIANT EXPERIMENTS OF NIKOLA TESLA, THE ABLE AND PROGRESSIVE YOUNG INVENTOR.

One of the prominent features of the general meeting of the American Institute of Electrical Engineers, was the lecture by Mr. Nikola Tesla, on "Alternating Currents of High Frequency." Wednesday evening of last week, Professor Dwights' room at Columbia College, was filled to overflowing with an expectant audience eager to learn some of the results of Mr. Tesla's patient labors in a field that he has made particularly his own.

Mr. Tesla began by pointing out that the highest aim of the human intellect is to discover the secrets of nature, and dwelt upon the fact that discoveries in the domain of pure science are invariably accompanied or rapidly followed by practical applications which redound to the benefit of mankind. Approaching the subject in hand he called attention to the fact that while the experiments and theories of such able investigators as Drs. Hertz and Lodge had greatly increased our knowledge of electric waves, their production, behavior and effects, yet these able physicists had devoted themselves more particularly to the study of electro-magnetic waves, leaving on one side the static effects, which he, the lecturer, thought were of as great, if not even of greater importance.

With an alternating current of high potential and high frequency a very powerful electric field can be generated, capable of producing very startling effects, as Mr. Tesla proceeded to show. The machine for producing the current used in the experiments was an alternator, having 400 poles, and, although Mr. Tesla did not give the actual number of revolutions per minute, he stated that the periphery of the armature was traveling at about the speed of a bullet.

The frequency was stated to be about 18,000 to 20,000 complete alternations per second. By means of a large induction coil the tension of the current from this machine was raised to the extraordinary figure of 250,000 volts. Although the very sound of the words "a quarter of a million volts" raised a feeling of uneasiness in the minds of even the more experienced of Mr. Tesla's hearers, the lecturer demonstrated the harmlessness of the high frequency current by grasping the two poles of the induction coil, one in either hand, and taking the full current of the secondary without apparently feeling the slightest ill effect.

One of Mr. Tesla's strong points was the important part that condensers will play in the distribution of alternating currents of high frequency, and quite a number of his very beautiful experiments were designed to illustrate this effect. For instance, with the secondary circuit of the induction coil open, he showed that by grasping a metal sphere connected to one pole the discharge was greatly increased. This effect was due to the introduction of the extremely small capacity of the human body, which resulted in raising the potential of the secondary current, thereby producing the effect described. This action of a very small capacity was shown in a number of ways, and an extremely beautiful illustration was given by twisting a short length of cotton covered wire round one pole of the induction coil, bending the wire upward in the form of a twig. The lights being turned completely out, the discharge was seen to take place along the whole length of the piece of wire, and when the lecturer's capacity was connected to the other pole of the coil the discharge was increased to a brilliant shower of sparks from the piece of wire.

To describe all of Mr. Tesla's experiments, and all that he said could be done with alternating currents of high frequency, in the space we have at command, and writing as we do from memory only, would be manifestly impossible. He showed in many ways the effect of capacity on the current and thoroughly revelled in the electric field generated by his 400 pole alternator and powerful induction coil. Geissler tubes three feet long were converted into brilliant beams of light by being held near the coil or near a large sheet of tin-plate connected to one of its poles. The lecturer stated that had the time at his command permitted him to make the necessary arrangements, he could have produced an electric field capable of lighting up the whole room by means of similar tubes or lamps suspended at intervals from the ceiling.

With lamps, similar extraordinary experiments were shown. Here Mr. Tesla seemed to act the part of a veritable magician. It seemed to make little difference whether the lamps were lying on the table or whether they were connected by one terminal to one pole of the coil, or whether the lecturer took a lamp in each hand and held one to each pole of the coil, or whether he short-circuited them across a stout copper conductor (bent in the shape of a tall arch), which was being traversed by the current; in each and every case the filaments were brought to incandescence, to the supreme delight of the spectators.

Probably the interest of the various members of the audience varied according to their electrical knowledge or their thirst for it; to many of those present the experiments may have seemed somewhat in the line of a brilliant exhibition of fireworks. To others, who appreciated the true inwardness of what was being done and shown, and who followed the lecturer with rapt attention for three hours, it was evident that a distinct advance had been made in scientific research and that a vista of yet more wonderful results than those we have briefly alluded to above was opened up.

We understand, that even in the considerable time which Mr. Tesla devoted to our enlightenment, he was unable to show us all, or nearly all, that he was able to and had hoped to. In this case we trust that the Institute will prevail upon him to bring the subject again before its members, all of whom must assuredly be anxious to learn further what the results of his labors and investigations have been.

We take it for granted that Mr. Tesla has advanced his work on alternating currents of high frequency to within a measurable distance of elaborating practical applications for the production of light. Probably one of the most formidable difficulties will be found in the vexed problem of insulation. Mr. Tesla, for instance, showed that the discharge passed with the greatest ease through plates of hard rubber or glass and even through a thick book, considerable heat being developed in the operation, resulting sometimes in the welding together of the plates of hard rubber, if several were used.

It is questionable, however, whether the discharge in this case actually passes through the dielectric, piercing it. The more probable explanation of what takes place is that it is due to condenser effect, the discharge passing by reason of induction from plate to plate, or, from one side of the plate to the other, actual perforation of the plate only taking place when the dielectric is sufficiently heated by the rapid discharges to cause its conversion into a moderately good conductor.

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire & Co., Electrical Securities, 18 Wall street, N. Y., Saturday, May 23, 1891. New York, Boston and Washington Stock Exchanges.

NEW YORK.	
Western Union Telegraph Co.	80¼
American Telegraph & Cable	
Central and South American	145
Mexican	205
Commercial Cable Co.	105
Postal Telegraph Cable	39
Edison General Electric Co.	101
Consolidated Electric Light	
Edison Electric Illuminating Co.	76
United States Electric Light	30
North American Phonograph	
BOSTON.	
Thomson-Houston Electric Co.	44
" " " Preferred	25½
" " " Series C	
" " " Series D	7¾
" " International Co	
" Welding Co	
" European Welding Co	
Ft. Wayne Electric Co	12
Detroit Electrical Works	11¾
Westinghouse Electric Mfg. Co	14
TELEPHONE:	
American Bell	199
Erie	48
New England	
Mexican	100
Tropical American	.50
MISCELLANEOUS:	
Edison Phonograph Doll	.50
WASHINGTON.	
Pennsylvania Telephone	25
Chesapeake and Potomac	59¾
American Graphophone	6¼
United States Electric Light (Wash'ton)	159
Eckington and Soldiers' Home Electric Railway	48
Georgetown and Tennallytown	58

Telephone News

*** The Erie Telephone Company's subcompanies made a net gain of 113 subscribers in April.

*** The Erie Telegraph & Telephone Company will hold its annual meeting at the Hotel Imperial, New York, Tuesday, June 9.

*** The Mexican Telephone Company is understood to have settled the claim of the Bell Telephone Company for profits on the instruments which its contract required it to take, but which it had no need to take, upon advantageous terms. This, it is said, relieves the company from debt, leaves it with some thousands of dollars in the treasury and with a monthly net income of about $2,000.

*** The American Bell Telephone has secured a final decree in the Federal Court, Chicago, against Arthur F. Arnold, who manufactured and sold telephone receivers which infringed on the Bell patent. Arnold made the peculiar defense that he sent the receivers out in sections, and if there was any infringement it was on the part of the people who bought the sections of the receiver and put them together and used them.

*** An extensive telephone service is to be put into the Thomson-Houston Electric Company's factories at Lynn, Mass., immediately. There will be 50 telephones, 30 of them in the factories, one for each foreman, and 20 in the office building at the desks of the different heads. This is the system in use in the Boston office, by which it is possible to talk by special wire in the Lynn factory to the desk of any one who is wanted in Boston. The exchange will be in the office building.

*** The Pacific Telephone and Telegraph Company has filed a communication with the San Francisco Board of Supervisors certifying under oath that the company has expended in laying conduits for carrying wires underground the sum of $53,369.76. The franchise granted to the company required it to expend $50,000 during the first year. The Pacific Telephone and Telegraph Company is placing the wires of the Pacific Bell and Sunset Telephone Company under ground.

*** The following action was recently brought before Justice Leonard, in the county court at Portsmouth, England. The Western Counties Telephone Company sued Mr. Harry Wainscot, a solicitor, for £10, being the rent for the use of an instrument. On the other hand, the defendant set up a counter claim of £10 on the ground that the service had been frequently interrupted. He claimed that he had been subjected to much annoyance in the practice of his profession, owing to the irregularity with which the plaintiffs had performed the work they had contracted to do. Justice Leonard awarded the plaintiff £10 and the defendant £5 on the respective claims, on the ground that he considered the defendant had not received the service the company had contracted to supply.

A New Graphical Method of Calculating Leads for Wiring.

READ AT THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, MAY 20, 1891, BY CARL HERING.

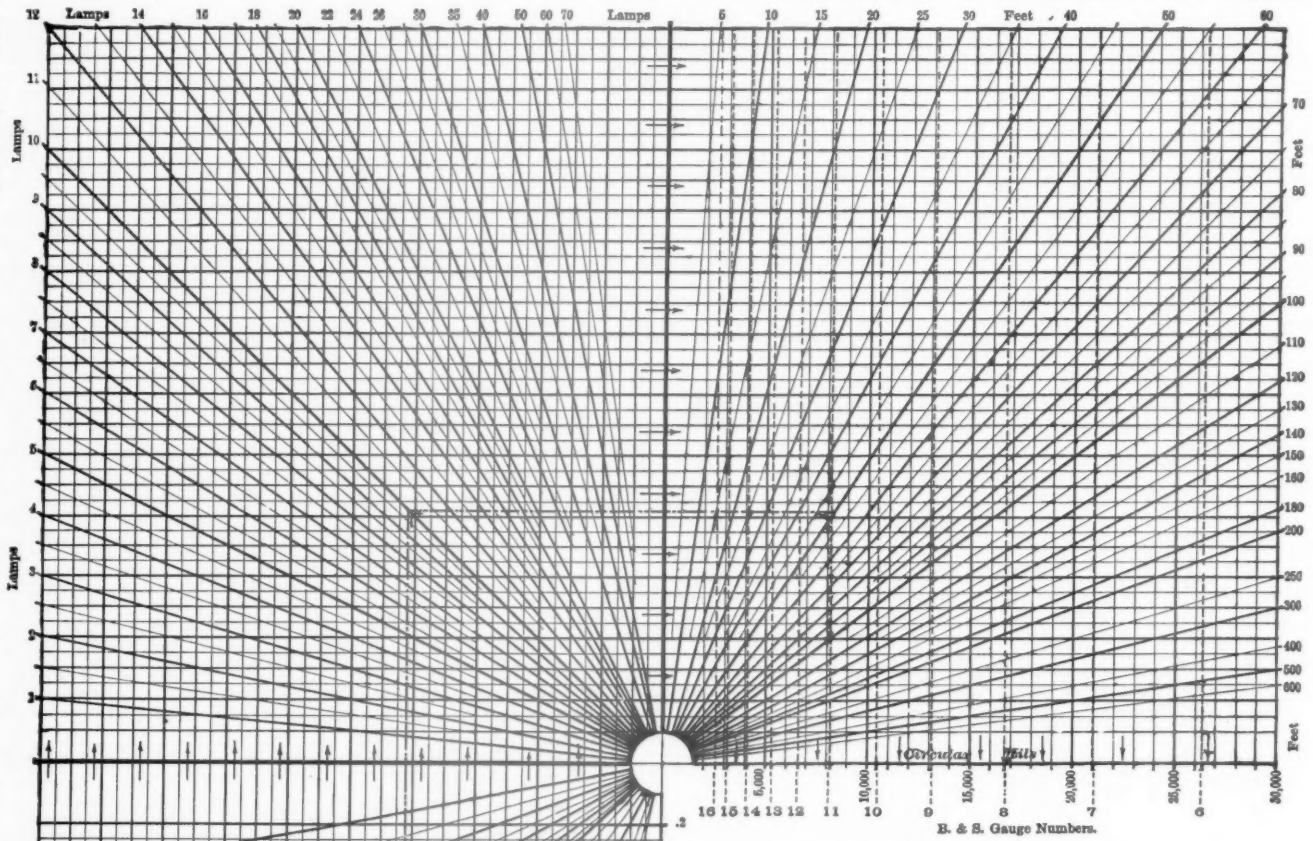
The subject of the calculation of leads for wiring has been written about in periodicals and books so often that it may almost be necessary to preface this paper with an excuse for again bringing up, at this meeting, such a simple and threadbare subject. The calculation of a single pair of leads is such a simple matter that very little need, or can be said about it; the formula, if not at hand, can be deduced about as quickly as it could be looked up. But simple as this calculation is, if it has to be made not only tens, but hundreds of times, a method which shortens this work may, perhaps, be of interest to those whose misfortune it is to have much of this uninteresting work to do. The following suggestions of a graphical method is an attempt to reduce this work to what might be called "machine methods," by substituting for the usual figuring, a simple graphical device which requires no figuring at all, and which is, at the same time, universal in its application, as it is adapted equally well for any of the many different lamps in the market to-day.

Makers and users of one particular lamp can readily calculate a wiring table for that lamp, for each of a few of the usual losses in the leads, and such tables are often quite convenient for those particular conditions; but it is evident that they are limited to those fixed conditions. Their scope can be increased by making simple reductions, but they may then become dangerous tools in the hands of many mechanics who may readily fall into such errors as multiplying instead of dividing by two. Furthermore, such tables are not generally applicable to branched leads, which are so common in wiring, and mechanics (they cannot be called electricians) have frequently made the error of determining from the tables each successive section of a branched wire for the total loss. It is no wonder, then, that they can underbid their competitors. To make a set of tables large enough to cover such fractional losses means to multiply their number considerably. If, in addition to this, such a set of tables is to include all the many different lamps of different makes and candle-powers, it is readily seen that the number of tables which become necessary would be greatly burdened by the searches for the special table required for each calculation. As long as there are lamps of such different amperage and voltage it would hardly be practicable to make a universal set of tables, especially when the currents which the lamps take are greater than what is claimed for them.

Graphical methods, therefore, suggest themselves, for in these the size of the diagrams does not increase nearly as rapidly for an increased scope as the number of tables would. Graphical methods have been devised to replace the tables, but they have not been satisfactory for various reasons. As early as 1884 a diagram was devised by Emil Waldstrom, which was universal in its scope and exceedingly ingenious. It was based on logarithmic functions and gave not only the cross-section, but also the diameter of the wire for any lamps, distances or losses. But the dense network of lines, and the method of using it, were so complicated that only technically trained engineers would be likely to apply it in practice. In the same year the writer devised and used a diagram totally different in principle, which had the advantage over the other in being so simple that it could readily be understood; in fact, it could not be misunderstood, as there was only one set of diagonal lines. It consisted merely of a right angle and a series of diagonal lines drawn through the center, the background being cross-hatched. It was not universal, however, as it had to be made for each special lamp; but it had the redeeming feature that any one could readily make such a diagram on cross-section paper for any particular lamp and scope. This diagram was described by the writer in the *Electrical Engineer* of January, 1887, and is, doubtless, known to many, as it has since been copied and published by some one else in a well known book on wiring though without any acknowledgment of the true authorship. This diagram, however, is only a partial solution of the problem, as it performs only two of the three multiplications and divisions required by the formula; it is necessay first to multiply arithmetically the number of lamps by the distance in feet, the diagram will then perform the remaining multiplication and division, both in one operation, giving as the result the size of the wire or the gauge number. To attempt to give on a regular scale the diameter of the wire as distinguished from the cross section would require a series of parabolas to be drawn; this would render it practically out of the question for any one to make the diagram himself. The simple device was, therefore, resorted to, to use a regular arithmetic scale of cross-sections, instead of diameters or gauge numbers. All the lines then become straight diagonals and are, therefore, very easily drawn. Furthermore, the different factors which enter into the calculations were so placed on the diagram that the series of hyperbolas called for by the formula resolved themselves all into straight lines.

The objections to this method were that it required a different diagram for each different lamp, and that it did not multiply the number of lamps by the distance in feet. The object of the present diagram is to overcome these two objections. This was accomplished by the simple device of having three of these diagrams or sets of diagonals placed next to each other, as shown in the accompanying diagram, so that a line could be followed readily from one to the other, thus enabling a series of multiplications and divisions to be performed. The diagrams might have been superimposed on each other, but this would make a confusion of lines.

As this same principle of making a succession of calculations graphically may be applicable equally well to other formulæ besides that for wiring, it may not be out of place here to explain the principle before showing how this particular diagram is to be used. The general principle may be laid down that, for any formulæ containing three variable quantities, one of which is the product or the quotient of the other two, the "curves" representing their relative values may always be represented by a series of straight diagonal lines drawn through the center or zero point. Such a set of lines will, therefore, enable one to make any calculations graphically for that formula. For instance, horse-power is equal to volts multi-



FEW LAMPS AT SHORT DISTANCES.

Rule for using the chart:

Follow the general direction of the broken line and the arrows, from one set of diagonals to the next.

EXAMPLE: What size wire is required for 10 lamps of .775 amperes each, at 50 feet, for a loss of 1 volt?

SOLUTION: Starting with the current for 1 lamp, .775 amperes (see scale below center), follow it (see broken line and arrows) to the left, until it intersects the diagonal representing 1 volt loss; thence up to the diagonal representing 10 lamps; thence to the right to the diagonal representing 50 feet, and from here down to the scale of the circular mils or gauge numbers, on which the reading is found to be about 8,200 circular mils, or a No. 11 B. & S. wire.

For a more detailed explanation, abbreviated methods and general hints, see text.

(Chart A.)

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plied by amperes; the constant 746 does not concern us at present. A series of diagonal lines properly spaced will, therefore, give directly either the horse-power, the volts or the amperes, when the other two are given. The curves may also be made hyperbolas, but it is evidently absurd to draw hyperbolas when straight lines answer just as well, and are even more accurate, as they can be laid off and drawn with great precision. Notwithstanding this, such diagrams are often published as hyperbolas. The difference lies in the disposition of the scales. One scale is vertical, the other horizontal, and the diagonal lines (or the hyperbolas) each represent one unit (or number of units) of the third scale. To make the "curves" straight lines, the diagonals must be made to represent one of the two quantities, which is equal to the quotient of the other two, and not the one which is equal to the product of the other two, because the curves would then be hyperbolas. In the example given, the diagonals must represent volts or amperes, but not horse-powers. The constants in such formulæ affect only the positions of the diagonals; although they increase considerably the work of arithmetically calculating the results, they do not affect in the least the graphical calculations after the diagrams are once drawn. For this reason alone the graphical calculations are that much simpler.

Now, the general formula for wiring is as follows:

$$\text{Cross-section} = \frac{\text{current for one lamp} \times \text{number of lamps} \times \text{distance} \times \text{constant}}{\text{loss in volts}}$$

containing six quantities only, one of which is always constant, being equal to twice the mil-foot resistance of copper, if the cross-section is in circular mils. As we have just seen, calculations involving three of these five quantities may readily be made graphically by means of a single set of diagonal lines. For instance, for any one make of lamp the current per lamp is a constant, and may, therefore, be combined with the other constant as one; if, furthermore, the number of lamps and distance be multiplied together mentally and then used as one quantity, lamp feet, there are then only three variable quantities to the formula, and calculations can then be made by one set of diagonals. This will give the diagram mentioned in the early part of this paper. But a universal diagram must be equally well applicable to any lamp; and as graphical calculations are so much simpler, more rapid, and less liable to errors than arithmetical ones, it is preferable to multiply the lamps by the feet graphically also. Both of these may be accomplished by splitting up this formula into smaller ones, each of which contains no more than three variable quantities. Each formula can then be calculated separately by a simple diagram, as described, thus permitting the whole formula to be calculated graphically.

To do this, let the first diagram perform the calculation:

$$x = \frac{\text{current for one lamp}}{\text{loss in volts.}}$$

In which x is a mere auxiliary quantity. Let a second similar diagram perform the next calculation:

$$y = x \times \text{number of lamps};$$

and a third diagram the final calculation:

$$\text{Cross-section} = y \times \text{distance.}$$

The constant may be combined with any one of these, it is immaterial which one. This triple calculation may at first seem to complicate matters on account of the new quantities, x and y. These, however, are easily eliminated by the simple device of placing the three diagrams together, side by side, in such a position that the two x scales coincide, and similarly the two y scales. By doing this, one has merely to pass directly from one set of diagonals to the next to perform the successive steps of the calculation, without being concerned about the intermediate auxiliary quantities. These intermediate quantities correspond, and are equal to the successive products or quotients which are obtained in the successful arithmetical multiplications and divisions of these five quantities in the formula, which cannot, of course, be eliminated in making the calculations arithmetically, showing another great advantage of the graphical methods. This particular method of performing the successive calculations is, of course, not limited to this formula, which is used here merely as an illustration. Any other formula which may be split up into smaller ones, each involving one multiplication or division, can be calculated graphically by the same method.

In the accompanying diagram the formula just given is represented graphically as described. It will be seen to consist of three right angles, each with its set of diagonals and a common center. Each two right angles have one side in common which represent the quantities x and y, and which thereby drop out of consideration. The lower left-hand diagonals represent *loss in volts*, the upper left-hand, *number of lamps*, and the upper right-hand, *distances*. The remaining two of the five variables are represented by the starting scale vertically below the center, which represents the *amperage of a single lamp*, and the last scale, to the right of the center, which represents the final result, namely, the *cross-section*. The constant is included in any one of these three sets.

To perform the graphical calculations, simply follow from one scale to the next on the cross lined background up to the last scale, the cross-sections, which is the final result sought for. An example is worked out and illustrated by the broken line on the diagram. Starting first with the amperage of the particular lamp, .775, on the first scale, follow to the left (see the broken line) to its intersection with the required volt diagonal, 1.0 volt; thence up to the next diagonals, the lamps, 10 lamps; thence to the right to the feet diagonals, 50 feet; thence down to the scale of cross-sections, where the reading is about 8,200 circular mils, or about a No. 11 B. and S. wire; the whole operation requiring about as much time as it would take to start the arithmetical calculations.

The relative disposition of the scales is also of importance in such a diagram. For instance, the amperage of the lamp, is generally the same for a great many computations; it has, therefore, been made the first scale, so that it can be eliminated from all those computations by drawing a horizontal line, say in red ink, through this value and then starting all the calculations from this line, thus saving that first part of the work. Next to the amperage of the lamp, the loss in volts is often the same for many calculations; the volt scale has, therefore, been made the second one, so that it also may be cut out of these calculations. To eliminate this part, draw a vertical red line through the intersection of the ampere and the volt lines. All such calculations are then started directly from the intersection of this line with the lamp scales. Finally, by the dotted lines drawn through the last scale, as shown representing the cross-sections of the standard wire-gauge sizes, the last part of the work is also saved. The only operation left to be performed, therefore, is to follow a horizontal line from the number of lamps to the number of feet; it would hardly be possible to have it simpler. As the majority of calculations are made for the same amperage and loss, this represents the most frequent conditions under which the diagrams would be used.

The range of such a diagram can evidently be made very great by having several sets of numbers on the scales, each set being, say, ten times larger or smaller than the other, the position of the diagonals will remain the same. By an accidental coincidence the position of the dotted lines representing the B. and S. gauge numbers, will also remain very nearly the same for different scales of circular mils, even though they represent different gauge numbers. Furthermore, lamps and feet are interchangeable on the diagram. Although the same diagram may have several different sets of numbers, it is probably preferable to have a separate diagram for each set. A set of three diagrams, of which the accompanying is the first one, will probably cover the usual ranges. For motor currents the same diagrams may be used, by assuming that the current represents that number of one ampere lamps.

The whole diagram might have been made much smaller by superimposing the three parts over each other, instead of placing them next to each other, the principle remaining the same. The three centers of the diagonals would then be at the three corners of a rectangle. It was thought, however, that this might cause confusion, owing to the great multiplicity of crossing lines, and, therefore, be a disadvantage rather than an advantage.

There exists among many persons, unfortunately for themselves, a prejudice against any graphical methods of calculations. They appear to think that because such methods do not come within the narrow scope of their little multiplication tables, they must be something very difficult and complicated which would take too much time and trouble to master; and that such methods are suited only to professors and college men. In point of fact, graphical calculations are much simpler than ordinary multiplication, and very much simpler than division. Graphical methods share this unwarranted prejudice with other short and simple methods of calculations, such as algebra, the slide rule, logarithms, etc. All short methods carry their reward with them to such persons, and only to such, who take the small amount of trouble to master them. No one having many and complicated calculations to make, will ever regret it, if he spends a little time in becoming familiar with any or all of these short methods of calculating; it is his own loss if he does not take advantage of their existence.

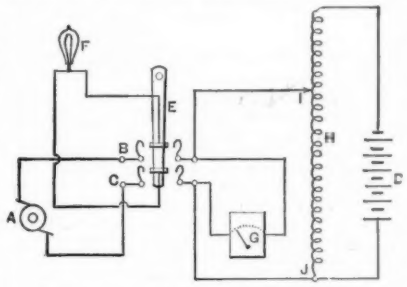
The Thwing Electric Company, of Chicago, has passed into the hands of the sheriff on a judgment note for $8,966.

An Alternate Current Potentiometer.

READ AT THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, MAY 21, 1891, BY GEORGE S. MOLER.

This device is designed for the purpose of determining what values of the potentials of alternating currents will produce given effects, and is intended to be used mainly in calibrating alternate current voltmeters. It may also be used as a voltmeter, applying it directly to the alternate current to be measured. By means of this apparatus we may determine whether the instrument which is being calibrated changes its reading for other rates of alternations. This is shown by comparing the calibration curves obtained by using widely different rates of alternations.

The instrument, briefly described, is as follows: An incandescent lamp is so arranged and connected that it can be switched back and forth from the terminals of an alternating current line to those of a direct current line, which can be altered in voltage till the lamp glows with the same intensity when fed by either line. Then, while switched into the direct current line, the voltage of that line is measured by a direct current standard voltmeter or potential instrument, and the voltage so read is equivalent to that of the alternating current, which produces the same effect in the lamp. The switch is so constructed that it snaps back and forth, making the change of connection so quickly that the slightest change of intensity of the light can be easily detected. The



ALTERNATE CURRENT POTENTIOMETER.

lamp has a blackened hood with an opening in one side through which it is viewed while the sliding resistance is being adjusted. This enables the observer to make a much closer setting than otherwise. A very close setting may also be made by observing the slight reflection of the light from the blackened surface of the hood.

The lamp and switch are arranged and connected in the following manner: Referring to the diagram, A is the alternate current dynamo, or line, of which we wish to determine the effective difference of potential in volts between its two terminals, B and C; D is a storage battery or direct current dynamo of higher voltage than the alternate current to be measured. A switch, E, made to snap back and forth by means of a stiff spring, changes the incandescent lamp, F, from the alternating current to the direct current and *vice versa*. By connecting the two extremities of a resistance, H, to the battery, D, and sliding the contact point, I such a place can be found that the intensity of illumination will be the same for both currents.

After the contact, I, is adjusted, the standard voltmeter, G, is read while the direct current is flowing through the lamp, and this voltage is taken as the equivalent voltage of the alternate current.

A series of lamps of different voltages affords a greater range to the instrument than can be obtained with one lamp only. These may all be connected to the switch, and beginning at the one of highest voltage, one after another may be tried till the best one is found.

For higher voltages than the highest voltage lamp will stand, a number of lamps may be used in series, and the fall of potential for all, or for each individual lamp, can be measured by means of its voltmeter.

The resistance, H, must necessarily be great enough in amount so that only a small current will be allowed to flow through it, so that the consumption of energy will be small.

Instead of having the switch and lamp connected in a shunt line to the resistance H, it may be connected in series with H, which must then be arranged so that it can be varied in amount. If a source of constant potential large enough in amount is available, the apparatus may be used for a voltmeter for direct of alternating currents. To use it in this manner, we calibrate the apparatus to find the potentials at the terminals of the lamp for different positions of the contact points I and J, and construct a curve, using the positions of I and J as abcissæ and the differences of potential of those points as ordinates. Then, when using the apparatus as a voltmeter, we read the values from this curve instead of from a voltmeter connected to the switch.

The apparatus was tested in the following manner to determine its sensitiveness, and to what extent its indications can be relied upon: The terminals B and C were connected to the same resistance H by two other contact points, and these connections were changed several times to include different amounts of that resistance. Each time this was done the contact point I was moved along till the lamp seemed to indicate the same candle power for both positions of the switch. The readings of potential for both positions were then made upon a standard potential galvanometer which has a scale graduated to millimetres, and upon which a double deflection of one cm. means one volt. Upon this instrument readings could be estimated to one-tenth of a mm., giving volts to the second decimal place. The accompanying table of results were the first part of the first set taken in this manner and were consecutive. They were taken without any preliminary practice. From this it will be evident that the adjustment of the light can be made to within one-tenth of a volt.

LEFT CONTACT. VOLTS.	RIGHT CONTACT. VOLTS.	DIFF.
29.95	29.85	+.1
29.62	29.60	+.02
33.07	33.11	—.04
37.56	37.55	+.01
42.52	42.60	—.08
60.95	60.90	+.05
74.68	74.72	—.04

Physical Laboratory of Cornell University, May 9, 1891.

TELEGRAPHIC

.... The telegraph line between Fairhaven and Blaine, Wash., has been completed.

.... Mr. Frank A. Douglas has been elected superintendent of fire alarm of Lockport, N. Y. The Gamewell system is used there.

.... Professor Preece's recent experiments in telegraphing without wires has led to the suggestion that the method be employed in communication between light-ships and the coast.

.... In the case of The Commonwealth of Massachusetts *vs.* The Western Union Telegraph Company, the validity was questioned of a law of Massachusetts which taxed the buildings, machinery and other property of the company within the State, first ascertaining and deducting the amount of property of the company already assessed by municipal or other local authority. The Supreme Court of the United States upheld the validity of the law, but directed certain modifications to be made in the judgment of the state court.

.... The annual meeting of the stockholders of the American District Telegraph Company was held May 18, in the executive offices of the company, No. 113 South Broad street, Philadelphia. The following board of directors was elected: C. Hartman Kuhn, president; Theodore M. Etting, vice-president; M. Richards Muckle, secretary-treasurer; Edw. J. Mathews, George Kelly, John Rommel, Jr., Edward C. Platt, Henry Nuss, Jr., Benoni Frishmuth. The report of President C. Hartman Kuhn and the directors showed the gross earnings of the company for the year ending May 1, 1891, to have been $114,036.81. During the year the company has handled 592,146 messages, among which were 400,006 for the Postal Telegraph Company, 19,951 for the Western Union Company and 24,571 for the American District Company. George J. Jewell was made general manager and William L. Fry assistant secretary.

* * The North Beach and Mission Railroad Company, San Francisco, last week called a meeting of stockholders to create an indebtedness of $1,000,000, which is to be used in changing the road from a horse car to an electric line.

* * The directors of the Wilmington, Del., City Railway Company and the Front and Union Street Railway Company, at a joint meeting last week, adopted a uniform rate of five cent fares, good for transfers from one line to the other and over the branches.

* * At a session of the common council at Providence, R. I., May 18, an ordinance permitting the Union Railroad Company to operate the single trolley system on its Pawtucket route, a stretch of about five miles, with double tracks in the lower part of Broad street within a block of the center of the city, was passed. The ordinance now goes to the board of aldermen for concurrent action.

PERSONAL.

Commodore Charles A. Cheever, for many years president of the Okonite Company, and more recently identified with the promotion of the phonograph, left New York last week to cross the Atlantic in a sailing vessel, the U. S. school ship St. Mary's. The Mediterranean will be visited, the trip extending over a period of several months.

Capt. Henry Erben, U. S. N., most popularly known to many members of the electrical fraternity, has recently been made commandant of the Brooklyn Navy Yard. The Captain is one of those level-headed and whole-souled gentlemen that promotion never spoils. The REVIEW congratulates the accomplished warrior of the sea on his deserved honors.

Mr. S. Ashton Hand, of Philadelphia, a widely known mechanical engineer, member American Society Mechanical Engineers, and lately general superintendent for Morris, Tasker & Company, has joined the forces of the Equitable Engineering & Construction Company. Mr. Hand will take entire charge of the mechanical engineering department of the Equitable Company, whose offices are in the Drexel building, Philadelphia.

LITERARY.

"Reports from the Consuls of the United States," for March, 1891, has come to hand.

"Postal Savings Banks: An Argument in Their Favor by the Postmaster-General," has been received.

"Report of the Eighth Annual Meeting of the Street Railway Association, of the State of New York," held at Rochester, N. Y., September 16, 1890, has been received.

Prof. Elihu Thomson's recent lecture on "Light" before the Electric Mutual Benefit Association, of Lynn, Mass., was reported *verbatim* by John W. Giboney, of the Thomson-Houston Electric Company, and has been published by him in an attractive volume of 36 pages.

"Transactions of The American Institute of Electrical Engineers," for May, 1891, gives the papers on "Electricity in the Production of Aluminium," by Alexander S. Brown, and "Some Possible Modifications in the Methods of Protecting Buildings from Lightning," by N. D. C. Hodges.

The many admirers of "A Social Departure," and "An American Girl in London," the brilliant books by Miss Sara Jeannette Duncan, should bear in mind that the only complete and unmutilated editions are those published by D. Appleton & Company. The editions published by this house are authorized, and represent a recognition of the author's rights. Any other editions are dishonest in a double sense, since they are incomplete, and purport to be what they are not; and they also represent a theft of the author's work.

The Portelectric System.

About a year and a half ago a representative of the ELECTRICAL REVIEW visited the Old South Church in Boston to inspect a working model of the portelectric system. As is well known, this is an electric automatic system of rapid transit for mail and express matter. The exhibition in the Old South Church was entirely successful, but since then efforts have been made to determine all the conditions necessary for the construction of a commercial line for practical business purposes. With this object in view an experimental plant was set up at Dorchester, Mass., a suburb of Boston, and here a great number of tests of the device have been made.

Prof. A. E. Dolbear, the electrician of the Portelectric Company, has recently rendered a report, from which the following extract is made:

"The oval track (shown in the accompanying illustration) is 2,784 feet long, and the curves are much too short to attain the high speeds attainable on a straight line. When the car was first sent around the track it made the circuit in about two minutes; now it has made it in 51 seconds. The hindrances to still swifter travel are only the mechanical ones of proper track and alignment. That this is so is evident from the fact that an acceleration of six feet per second has been observed upon the iron car, which weighs about 500 pounds; an acceleration which, if maintained for 30 seconds, would give it a speed of 180 feet per second, a little more than two miles a minute."

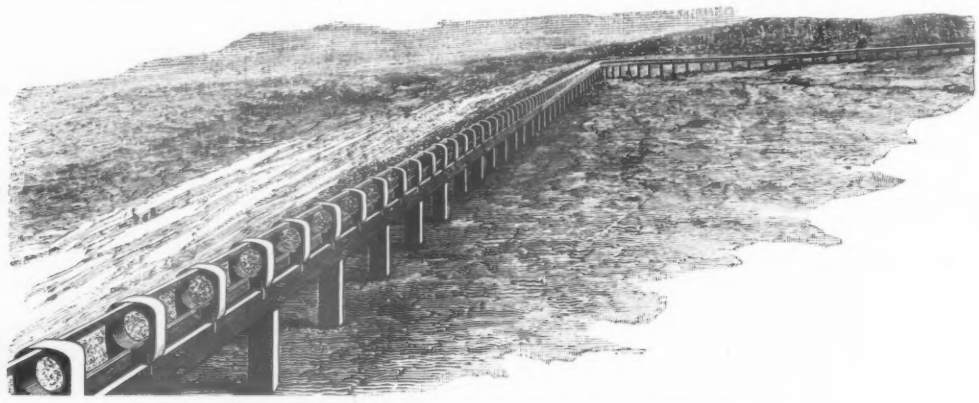


FIG. 2.—VIEW OF PORTELECTRIC LINE AT DORCHESTER, MASS.

It would appear from Professor Dolbear's words that the only impediments to the attainment of higher speeds are mechanical, and of such a character as to be easily remedied.

The experimental car is hollow and has an interior capacity of about five cubic feet, and is, therefore, capable of holding about 10,000 letters, which would weigh 180 pounds, or the space could be filled with other packages. It is expected that a still greater capacity in the car can be had with as great an efficiency in power and speed.

Professor Dolbear concludes his report as follows:

"Aside from being simple, and light in weight, it is completely automatic, both starting and stopping, and needs no guide nor attention, and is thus in strong contrast with all other electrical devices that have been proposed for doing similar work. The track and helices also are subject to but little wear and tear and are extremely durable. There is no reason why such a car should not start for a 1,000 mile journey as well as for one of 10 miles.

"The work in Dorchester has demonstrated that the Portelectric apparatus is simple, easy to construct, and durable.

"That with it exceeding high speeds may be attained.

"That its cost per mile need not exceed $20,000.

"That its cost of running and maintenance is low.

"That it is antomatic, and may be trusted."

Mr. Franklin L. Pope, of New York, has also made a report upon the portelectric system. He describes the experimental plant as follows:

"The experimental plant at Dorchester comprises an endless track, elevated upon a wooden trestle a few feet above the ground, 2,784 feet in circuit, consisting of one tangent of 588 feet, and another of 576 feet, united at their ends by two curves, one of which is 924 feet long and 282.5 feet radius, and the other 696 feet long and 234.4 feet radius. The track in the first tangent of 588 feet, is level, while in other portions of the circuit are grades rising to a maximum of 4½ per cent, or 227 feet per mile.

"The track consists of an upper and lower rail, formed of bar steel three-quarter inch by one-quarter inch, fastened by countersunk screws to stringers. The upper stringer is of wood, two inches square, and the lower also of wood, two inches broad by four inches deep. The upper rail is supported and braced at intervals of about three feet.

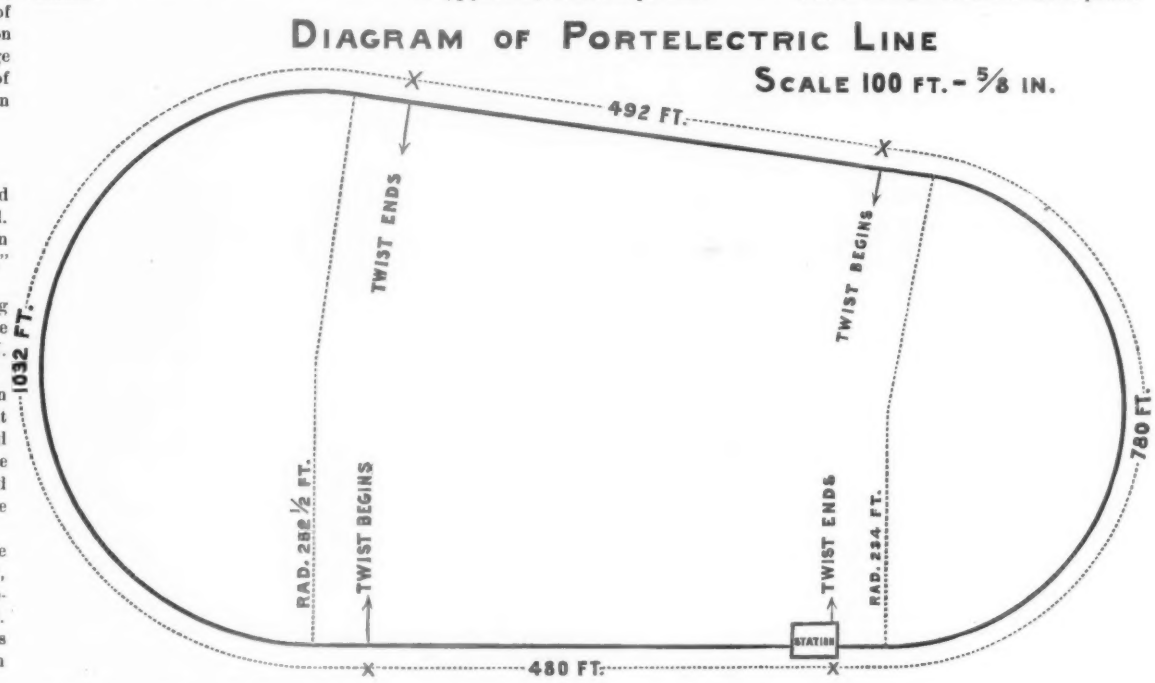
"The carrier is virtually a hollow projectile of wrought iron, cylindrical in form, with ogival ends, the cylindrical portion being eight feet long and 10 inches in diameter, the length 12 feet over all, and the weight approximately 500 pounds. It has capacity to contain, say, 10,000 letters, weighing, perhaps, 175 pounds. It is provided with two flanged wheels above, and two underneath, all of which, being fitted with ball-bearings, revolve with very slight friction.

"The propelling power is derived from a series of hollow helices of insulated copper wire, each of which encircles the track and carrier. These are fixed along the permanent way at intervals measuring six feet from center to center. Each helix is composed of 630 turns of No. 14 copper wire, in five layers, weighing about 20 pounds, and having a resistance of about five ohms. A contact wheel, mounted upon the carrier, and running in contact with the upper track rail (which is divided into sections, and utilized as an electric conductor), connects the several helices in succession with the source of electricity as the carrier moves forward upon the track.

"The electric current is supplied by a dynamo having a maximum capacity of about 8,000 watts, or a little over 10 horse-power, driven by a steam engine rated at 10 horse-power.

"Experiments were first made to determine the maximum speed of carrier which could be obtained from the appliances in use at the time of inspection. This was found to be 2,784 feet in 56.5 seconds, or 49.3 feet per second, equal to 33.5 miles per hour.

"The consumption of electric current or rate of electric work while the carrier was in motion could not be determined with strict accuracy, owing to the irregularity of the current, which caused the meters to fluctuate, but was approximately 200 volts and 38 amperes, equal to 7,600 watts. It may be stated with sufficient accuracy as between nine and ten electric horse-power.



"The tractive power of the helix upon the carrier was measured by an improvised dynamometer, the indications being read from a spring-balance. The maximum tractive effort with a current of 10 amperes was found to be 80 pounds. The electrical force producing this magnetic attraction was 6,300 ampere-turns.

"Experiments were made upon a section of level and straight track to determine the rate of acceleration, from which the average tractive force exerted by the helices upon the carrier while in motion may be deduced.

The performance of the driving engine and dynamo were not very satisfactory upon this occasion; but, by combining the results of my own observations with the results of independent observations at different times, furnished by yourself and Professor Dolbear, I think I may safely put the rate of acceleration as high as 4.5 feet per second. The force of traction required to produce this acceleration, with the carrier of 500 pounds' weight, is as follows: 500 ÷ 32.17 (acceleration of gravity)=15.54 + 4.5=69.93 (say 70).

"The rate of acceleration with a given tractive effort becomes less and less as the velocity increases, until it is balanced by the constantly increasing resistance, when the motion becomes practically uniform. A tractive effort of 70 pounds, exerted upon the carrier moving at the rate of 50 feet per second, requires the expenditure of 6.3 horsepower, or 4,712 watts. As the average electrical energy supplied appeared to represent something like 8,000 watts, the efficiency of the helices and carrier, considered as an electric motor, may be estimated at about 60 per cent., which figure agrees very well with other determinations of solenoid magnets.

"It is evident that in order to render the system of commercial value the speed of the carrier must be greatly increased beyond that which has been found to be attainable with the existing experimental plant.

"The results of this investigation have convinced me that efforts for increasing the efficiency and economy of the portelectric system should henceforth be directed mainly to the improvement of the track.

"I see no reason why the speed should necessarily be limited to 150 miles per hour, but have taken that speed as one which is high enough to be of great commercial value, and yet low enough to be susceptible of having its condition calculated from known experimental data. That this speed can be attained with a carrier of the dimensions of that now in use in the experimental plant, with not more than half the weight of copper per mile there used, and with no greater expenditure of power per mile run, I have every reason to feel confident from the considerations which have been adduced."

The power house of the plant at Dorchester is shown in Fig. 1, and a view of the experimental line in Fig. 2. Fig. 3 shows the car and a section of the structure. Mr. John T. Williams, of Boston, is president of the New England Portelectric Company.

New York Electric Club.

A meeting of the Club will be held on Thursday, May 28, at 8 P. M., at the Club House, when Mr. Hiram Maxim will give a talk on "The Tools of Modern Warfare," with practical illustrations. Mr. Maxim is in this country for the first time in many years, and on but a short visit, and the entertainment committee believe that the members will welcome heartily the opportunity of entertaining and listening to this distinguished inventor and pioneer electrician on so important and interesting a topic. Mr. Maxim will discuss more particularly quick-firing guns and the questions of aerial navigation and combat.

The Manufacture of Submarine Cables.

In a recent issue we drew attention to the inauguration of the ocean cable factory of the Société Générale des Téléphones, at Calais. This event is worthy of note for the reason that the submarine cable industry during the 40 years that it has existed has remained, as far as important works are concerned, entirely in the hands of our English cousins.

It is true that for many years submarine cables of comparatively short length have been made in this country, and one or two concerns, such as the Bishop Gutta Percha Company and Day's Kerite have a long and enviable record in this respect. In fact, the former company is probably the only one in the United States which has ever made a cable more than a few miles in length and for submersion in foreign waters. Some two years ago the Bishop works turned out

FIG. 1.—POWER HOUSE OF THE NEW ENGLAND PORTELECTRIC COMPANY, AT DORCHESTER, MASS.

40 knots of light cable, made to meet a novel specification, which were shipped to Honolulu and successfully laid between two of the Hawaiian Islands. Of late years other insulated wire companies of greater or lesser renown have taken up the manufacture of submarine cables, but only on the comparatively small scale with which this industry has always been carried on in this country.

The noticeable feature of the Calais factory is that it is equipped on a scale to compete with the great works on the banks of the Thames. A steamer with the requisite tanks and machinery for cable-laying operations is being built for the company, and the works are capable of turning out some 40 miles of complete cable per day. It is obvious, therefore, that no comparison can be made between an enterprise of this sort and any of our own cable factories, as has been suggested by some of our readers who noticed our previous reference to this subject.

It appears that there are numerous difficulties in the way of establishing submarine cable works in this country on a scale sufficiently extensive for undertaking the manufacture and laying of long ocean cables. Very large capital would be required for such an enterprise and the lack of experience in such work is sufficient to deter capitalists from risking their money. The scarcity of gutta percha is another formidable obstacle, while a few others can be found in the price of iron wire, our absurd navigation laws and the comparative dearness of labor in this country as compared with England and France. Much as we should like to see America take a hand in the great work of girdling the earth with the electric wire, we confess that the outlook is not hopeful.

Electric Rapid Transit for New York City.

William Steinway, of the Rapid Transit Commission, is reported to have said in conversation last week that plans for rapid transit on the west side had been practically determined upon. They will be made public in detail this week.

Mr. Steinway is said to have admitted that the proposed scheme includes a four-track electric road in parts underground, surface, and elevated. Below Canal street it is understood that the route lies underground.

Forty miles an hour is the speed aimed at and the four tracks will admit of express and way trains. It is Mr. Steinway's judgement that the proposed structure can be built in 18 months at a total cost of, perhaps, $50,060,000. The uptown section, he thinks, should be running in 18 months. The engineers have not yet considered the location of stations.

When the matter of the west side is disposed of, the east side will be considered.

Kind Words from New South Wales.

A subscriber of this journal, in sending us an extensive book order from New South Wales, takes occasion to compliment the REVIEW in the following agreeable manner:

"Your valuable paper, the ELECTRICAL REVIEW, is read with great interest here. Electric lighting and power are going ahead very slowly, owing, I think, to insufficient advertising. The proceedings of the Thirteenth Electric Light Convention are of special interest to us. *The* REVIEW *certainly leads and others follow.*"

Without desiring to appear in the light of giving vent to self-praise, something that our modesty will not for a moment permit, we beg the privilege of calling attention to the pristine truth in the last sentence quoted. We thank our friend of the south for his kind and comprehensive words.

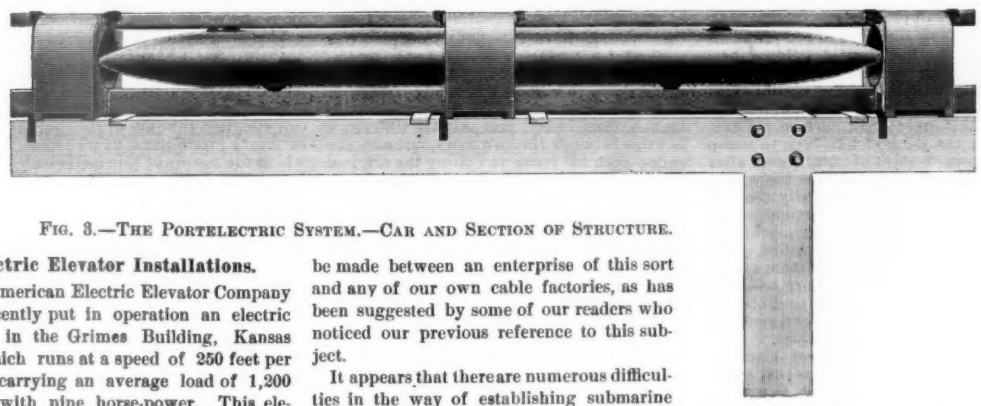


FIG. 3.—THE PORTELECTRIC SYSTEM.—CAR AND SECTION OF STRUCTURE.

Electric Elevator Installations.

The American Electric Elevator Company have recently put in operation an electric elevator in the Grimes Building, Kansas City, which runs at a speed of 250 feet per minute, carrying an average load of 1,200 pounds with nine horse-power. This elevator is giving great satisfaction, and runs more smoothly and quietly than the average hydraulic elevator, and nearly equal to the very best hydraulic.

They are now installing a number of their elevators in various parts of the country from Minnesota to Texas, and are at present at work on an elevator in the Duquesne Traction Company's car house at Pittsburgh, Pa., for the purpose of raising the cars, a load of 10,000 pounds, from the track on the first floor to the paint shop on the floor above. This elevator is expected to be in operation in a few days, and it will probably be the largest electric elevator in existence.

Suit has been brought in the U. S. District Court, in New York city, by the Tropical American Telephone Company, Limited, against the Western Electric Company, of New York, and Irving Loveridge, its agent, for infringement of Hyne's patent, No. 425,078, of April 8, 1890, covering the Williams annunciator drop used in telephone switchboards.

ELECTRIC LIGHT NEWS

—— Harvard University is to have its own electric lighting plant.

—— The Senate has refused to concur in the admission of the petition of the town of Everett, Mass., for authority to construct and maintain a system of electric lighting.

—— The Somerville N. J., Electric Light Company has voted to increase its capital stock to $50,000 in order to increase the capacity, and will remove the plant to East Somerville.

—— A press dispatch from Indianapolis, Ind., May 18, says: "The New Albany Electric Light, Heat & Power Company, capital stock, $75,000, assigned to Charles A. Sowle. Estimated liabilities, $50,000; assets about the same."

—— Sealed bids for lighting the City of Millville with electric lights will be received until June 10, 1891. Specifications may be obtained by addressing H. O. Newcomb, city solicitor, or "electric light committee," Millville, New Jersey.

—— The Hon. John J. Cassin, receiver of the Troy, N. Y., Electric Light Company, has been served with an order, issued by Supreme Court Judge Landon, preventing him from selling or offering for sale, either public or private, the property and assets of the Troy Electric Light Company. The stay is granted until Wednesday, June 10.

——The Denver, Colo., Consolidated Electric Company are preparing plans for increasing the West Denver station. The cost of the contemplated improvements, for the greater part of which contracts have already been let, amounts to $150,000. The company, which has been in operation since August 19, 1881, has now in operation 1,500 arc lights, 1,200 municipal street incandescent and 40,000 incandescent lights and 100 horse-power motor service.

—— The city board of trustees of Vallejo, Cal., awarded the contract of electric street lighting to J. George Gardner, of Washington, D. C., and John Maguire and Samuel Brown, both of Vallejo, Cal. The plant will include about 120 arc lights and 1,000 incandescent lights. The Ball system of arc lights will probably be used and the Loomis system of incandescent lighting. The capital stock of the company to be formed is $50,000, which amount is already subscribed.

The Sale of the Brush Electric Company, of Detroit.

News comes from Detroit, Mich., that the local Brush Company has been purchased by the Fort Wayne Electric Company. This is a very strong and prosperous company, and the Fort Wayne Company is to be congratulated upon securing the majority of the stock.

Mr. Wells W. Leggett, who has been president of the Brush Company for many years, and who was widely known in electric lighting circles, died last week, his death occurring, as a strange coincidence, on the very day that the control of the company passed out of his hands.

A great many electric light towers are used in Detroit, which are manufactured in Fort Wayne. It is stated that the new owners of the company have agreed to put $100,000 worth of new machinery and equipment in within the next year.

Commissioner Storm.

The vacancy in the Board of Electrical Control caused by the resignation of the late Daniel L. Gibbens was filled last week by Gov. Hill, who appointed Walton Storm to the place. Mr. Storm is a Tammany man, and treasurer of the Manhattan Athletic Club. His new position carries with it a salary of $5,000 per year.

The Practical Aspects of Electric Welding.

READ AT THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, MAY 20, 1891, BY FREDERIC A. C. PERRINE, D. SC.

It is hardly necessary to give any description of the general process of electric welding to the Institute of Electrical Engineers, or to follow Mr. Lemp's paper of last year and our interesting visit to the factory of the welding company with a detailed description of the machines. I intend rather to speak of them in their actual use, and to discuss some of the problems involved.

The plant with which I have been intimately connected, though not one of the heaviest, is still one making a great number of successful welds in a day, and is one in which the joints are required to be of the highest character and are subjected to the severest tests. The first machine actually sold by the welding company was bought by the Roeblings, but on account of the delay of the engine builders it was not in place and running for some six months, three or four months after other machines were in satisfactory operation. This was of the direct type, having a double winding on the armature, and the welding done on an apron immediately above the collector terminals of the heavy alternating coils; the pressure was applied by a handle regulated by the workman, the projection also being regulated by a scale stamped on the cam of the handle. Though considered crude, this machine did satisfactory work, often for 24 hours a day, and six days in the week, for about two years, having made about 370,000 splices in telegraph wire during its useful life.

After the automatic machines were brought to a reasonable perfection, we purchased a generator capable of welding up to one-half inch copper (40,000 watts), and installed one large transformer and seven smaller ones, of capacity from No. 4 B. & S. copper to No. 18 B. & S. These have been at the works something less than one year, and show a daily record of over 1,000 welds in copper and iron wire.

Our attention was drawn to the process at first as a possible solution of a very troublesome problem in preparing and packing iron telegraph wire. For the convenience of the telegraph companies, this wire must be put up in bundles measuring each exactly one-half mile of continuous length. It is very easy to say that the proper weight billets be bought, and the pieces kept continuous through all the processes of manufacture, but, as a fact, these pieces are necessarily irregular in original size, and are often broken in the process of manufacture, and, in consequence, it has long been the custom to make the proper weight bundles by recoiling and splicing with the common telegraph or Lippman's joint, after the wire has been galvanized, jointing before galvanizing having proved a failure on account of the acid carried over into the zinc pans by the great helix of the joints.

Singularly enough the telegraph companies which had for so long accepted as satisfactory these cumbrous connections, immediately commenced to complain of the large burr left by the welding machine, and which we had thought unnecessary to remove. An emery wheel solved this difficulty, however, and we were then able to defy them to find the joint at all. After a very complete series of tests on the joints themselves, the telegraph companies have been finally satisfied, and we are now able to make our bundles of the proper weight and length before the galvanizing is put on, and thus save one rehandling of nearly our whole product, besides having removed one of the greatest difficulties and causes of complaint.

"Shorts," as they are technically termed, in copper, are, of course, a still more serious source of loss, not only on account of the greater value of the material, but also on account of the greater liability of this weaker metal to break in the process of drawing, and also on account of the necessarily defective character of a joint in the insulation with which copper wire is usual covered when sent out from the factory. Cables, as you all know, must be made in exact lengths, many of which are often very great, and though a twisted soldered joint might be satisfactory at the bottom of the sea, or covered by a lead sleeve in a manhole, it could not for an instant be tolerated in the body of a cable which must, before completion of the cable, be passed through exact dies for covering with rubber or lead. Before the introduction of these machines, our custom had been to carefully scarf and fit the joint, which was then brazed with silver solder. While this method makes a strong joint, but little increased in resistance, and thoroughly satisfactory in other respects, it has the disadvantage of being rather slow and difficult to produce, on account of the necessary care in fitting the scarfed ends as well as in soldering and finishing.

Since last November, three boys on three machines have made, respectvely, in this work 10,570 welds, 7,642 welds, and 20,421 welds, the registers having been taken on April 16. Every weld is tested by bending and straining, and if one shows any weakness it is quickly cut out and made again, with the loss only of a very small amount of time and the royalty to the welding company. In all of our welding of sizes below one quarter inch the ends are prepared by cutting square across with a pair of pliers, and then setting the cuts at right angles to each other, touching only at the center from which the heat radiates to the surface; then after completion of the weld, the burr is removed by an emery wheel from the iron wire, and by a file from the copper. The preparation and finishing is a little more complex in the larger sizes, the ends are filed to a true butt and chamfered at the edges, and after a reheating in separate clamps the burr of the weld is forged to the diameter of the original rod. The necessity of this will be apparent later on. All of this work is done on either soft steel or copper wire, and is probably of the simplest character done on any machines made by the welding company, consequently, the advantages are not so apparant as where the welds are difficult in character on account of complicated shapes.

More varied work is done by the companies of whose plants I now give slight description as likely to prove interesting.

Messrs. Seward & Son, of New Haven, Conn., have at work a machine of somewhat universal character, its employment being principally in uniting Norway iron to Swedish steel, in such shapes as are required in carriage irons and fifth wheels. In this work the burr is removed by a drop hammer, at the same heat by which the weld has been made.

The crescent tires of the hundreds of bicyles manufactured by the Pope Manufacturing Company, are welded and afterwards formed by dies at the same heat. The material is soft steel. These people also have a machine for brazing their small parts.

Besides using the electric welding machine for their telegraph wire, the Trenton Iron Company, of Trenton, N. J., have boldly attempted to make a weld in a wire rope to avoid the tedious, and, with their locked wire rope, impossible operation of splicing. The ordinary joint in a wire rope is from 10 to 20 feet in length, and requires considerable skill on the part of the splicer and his assistants. The operation is to re-twist bunches of wire from opposite strands, and to tuck the loose ends under the adjacent complete strands, which then hold them in place. With the locked wire rope, which is itself but a single strand, the only successful method of joining opposite ends has been to fasten securely around each a cast-iron collar, and after abutting the ends in a welding machine, to cement the whole together and afterwards to break off the cast-iron collar leaving the rope as a solid bar for about two inches at the weld.

Among the new solutions of old problems accomplished by the electric welding process, is that of the manufacture of spinning rings by the Hopedale Machine Company, of Hopedale, Mass. The desideratum of these rings is a uniformly hard surface, to produce which the method has been to stamp the ring from a sheet of metal, and after finishing in lathe, to case-harden the whole, involving, as one would naturally see, the loss of a considerable proportion of the original sheet. With a welding machine it is possible to form these little rings, about two and a half inches diameter, from a piece of bar iron, and after the burr has been reduced by a series of dies, to finish as before, with the result of a decreased cost and an equally satisfactory product.

One of the largest and most complete plants at present in operation is that of the Studebaker Bros. Manufacturing Company, of South Bend, Ind They have at present nine machines; one of them for steel axles up to one and a half inches square. After the weld is made it is quickly removed to a drop hammer making about 300 blows a minute, then at the same heat the axle is set ready for the market. The test for these axles is to bend to 90 degrees while hot and then back to alignment. No instance has yet been reported of an axle breaking under this test, which is frequently made to insure perfect workmanship.

They have two machines for welding large car tires, about 4 inches wide and three-quarters of an inch thick, and smaller sizes. The weld is made in the usual way and then quickly removed to a hammer, where, by vertical and side blows, the burr is quickly removed. One hammer will easily take care of two welders in constant operation. They also have one machine for small carriage tires, one inch by one-quarter inch, and smaller sizes. In this case the burr is removed by one blow of the hammer, after which the tire is set cold by a machine they call a cold stover, which embraces the tire on all sides and, by great compression, sets it up to the felloe more quickly and as effectually as can be done by shrinking in the old method; this, of course, is an immense stain on the weld, being a compression beyond the elastic limit of the metal. They have two machines for the hub-bands, which are used on the wagon wheels, and they are able to turn out about 1,200 on each machine; besides these there are two or three machines for smaller miscellaneous work. All of the metal used by them is either iron or low grade steel. After the introduction of their plant, their machines made 360,000 welds inside of six months.

Probably the heaviest work done at present in electric welding, is that of the Johnson Rail Company, of Johnstown, Pa., who are not, as stated in the journals, welding long lengths of rails together, since with their continuous mill they already roll a rail too long to ship, but they find economy in the process in some details of their smaller manufactures. As to their results in general, they say: "We would state that over a year ago we put in one welder for general work. The bulk of the work done on this machine was work we had totally failed to do by hand welding, not on account of the difficulty of the weld, but on account of the general unreliability of the result. The result of a year's use of the electric welder was that we have not known one of the welds made by the method to fail, and we have closed contracts with the welding company for four 40,000 watt machines and two 89,000 watt machines, with the intention of adopting the method extensively in our works."

Agricultural machinery has generally been furnished with iron wheels, consisting of a malleable iron hub into which the spokes are upset, and of a rim into which they are upset at the opposite end. The electro-welding machine has given us two new wheels, each of which are supposed to be preferable to the one described. In the first, manufactured by the Electric Wheel Company, of Quincy, Ill., the hub is cast of malleable iron, with spokes about three inches long. To these are welded, by one machine, wrought-iron spokes, and again, by another machine, these spokes are upset into the rim, which is itself welded into a tire, the product being a wheel of which the spokes are less liable to rattle loose at the hub. The second method is that of Niles and Scott, La Porte, Ind. The hub in this case is composed of two drop forgings of low grade steel, grooved to receive the spokes; one-half is placed on the base of the welder and the spokes laid in their grooves, then the other half of the hub is put on and the clamp brought down. The current is then applied and the whole, spokes and hub, welded solidly.

The Rogers Typographic Company, Cleveland, Ohio, are practically welding brass to steel, making as high as 800 welds per day, and thus effecting a great saving in the manufacture of their typesetting and founding machines.

The hardest steel at present successfully worked by this process is the welding of band-saws by the E. C. Atkins Company, of Indianapolis, Ind.; besides the regular work of making the joint in continuous band-saws, these people have ingeniously adapted this method for replacing broken teeth in finished saws. Formerly they were compelled to cut down to a smaller size any saws from which one or two teeth had been accidentally broken, thus losing not only the difference in price between the two saws, but also the entire cost of labor in cutting the original saw. At present when a tooth is broken out, they fit in it a new tooth, which is electrically welded in place, and a drop of oil applied at the completing of the heat, restores the temper to a serviceable point.

This, one can readily see, is of the greatest value in reducing one of the sources of imperfect work.

Pipe welding, which we all saw successfully accomplished at the factory last year, is put in practice by the Pennsylvania Railroad Company, as well as by the Columbus Iron Works, Columbus, Ohio; Blymyer Ice Machine Company, Cincinnati, Ohio, and the Electric Pipe Bending Company, of Newark, N. J. This latter company is engaged principally in manufacturing long continuous coils for ice machines, blast furnace tuyeres and radiators. With this machinery they not only weld extra heavy black pipe, but also electrically heat the pipe with a machine 20 inches between the clamps for the purpose of bending to desired shapes over pipe formers.

With continuously spiraled coils of pipe it has been necessary for a smith to weld the whole length, 150 to 200 feet, before attempting to bend any portion of it, and then after once the bending operation has commenced, in order to get a uniform spiral, the heat is not altered or the bending operation suspended till the coil is complete. Under the present electrical methods the coils are continuously heated in a fire, and the coiling is continuous while one length of pipe is welded at a time, the operation being to attach the welding machine to the end of the moving pipe, and while the forward portion is undergoing the process of bending to weld on a new length, which will be accomplished in a sufficiently short time not to interfere with the coiling appartus. In all of this pipe welding the burr is beaten down by means of a pneumatic hammer, which is put in rapid motion by the act of closing it around the pipe, a rapid hammer having proved much more effectual than any press or dies. This is probably on account of the more rapid cooling action of the press, since no forming is attempted before the weld is completed and the current is turned off.

Three types of machines of importance are soon to be in use for the purpose of our army and navy, and the early recognition of the importance of this method of manufacture speaks well for the ingenuity of our government designers.

In the new wire-wound guns one of the most important specifications for the wire was that it should be readily jointed by the electric welding process, and in the Crozier gun now constructing the wire will be wound in one continuous piece under a constant and heavy strain. This wire is one-tenth inch square, with 180,000 pounds breaking strength and 100,000 pounds elastic limit, tinned as lightly as possible. The gun is to be made by winding the wire over a steel tube and shrinking a ring over the whole, for the purpose of longitudinal strength; the welding process is simply the same as that described for round wire, and is reported as having given satisfactory results.

For the Charlestown Navy Yard there is about completed a machine for welding ship chains up to two inch diameter links. These links are formed in halves and fitted roughly to each other, the welds being made in both sides at once by the same heat, which can be regulated to force either side at the will of the operator. When completed, both welds are forged immediately in a die by the same hammer. By this method only the points to be welded are heated, and as these are immediately forged, one could expect from the process a nearer approach to the strength of rolled metal than where the whole link is heated in the ordinary fire to a welding temperature.

The latest development for government work is the manufacture of conical shell and shrapnel for the smaller armor-piercing guns. With the modern types of armor a cast shell is not of sufficient strength to resist the shock of impact, and in consequence a chrome-steel point is welded to a tool steel body, embracing the powder cavity. This latter is small in comparison with that in the old round shell of revolutionary days, consequently the accurate forging of the interior becomes correspondingly difficult.

Cast shells are made from the higher grades of crucible steel, but with these the casting is both difficult and uncertain, necessitating a large amount to be allowed for machining to a uniform wall in the probable case of a decentered core. The electrically welded shells are made entirely of forged point, body and base, which may be finished to approximate dimensions, these requiring, after welding, a minimum amount of machining. The tests on these shells have resulted in a contract for a large number under a guarantee of the manufacturing company.

This brief sketch of the representative uses of the process I have given not only to show the practical application of electric welding, which are undoubtedly interesting in themselves, but with this introduction I wish to call attention to some of the limitations and necessary precautions, as well as to the light which the results of this method of applying heat to the metals throws upon some of the obscure and disputed points of structure and constitution

Welding in the ordinary sense on an anvil, by the means of a forge, is essentially the uniting of two surfaces of a metal which has previously been rendered plastic, and which, under the hammer, can be made to intermingle into a structure similar or identical to the original metal; in consequence, this can only be accomplished with materials capable of passing into a plastic state before actual melting takes place. One of the most familiar examples of this weld to electrical men is the common splice in the gutta percha core of a submarine cable. Provided only that the surfaces are clean, it is possible to make this material unite as perfectly as before it was cut. Amorphous waxes and similar substances can be treated by a like method, but when we reach truly crystalline materials it is no longer possible to effect this union below the melting point, unless great pressures are applied. In passing from the one to the other condition, we see the phenomenon of the familiar cementing of ice under pressure great enough to produce what is called regelation.

Now, viewing metals in the light of these simple examples, we find that it has long been possible to weld amorphous iron under moderate heat, but for the highly crystalline steels and other metals a pressure high

enough in ordinary practice has not been available.

Welding cold has been accomplished in a most striking manner by Professor Spring, of Liège. Using small cylinders filled with powders of highly cystalline metals, he has not only succeeded in compressing them into compact bars, but has also succeeded in making alloys with all the characteristics of the same alloys produced in the usual manner in a crucible. These results go very far towards proving the absolute possibility of a weld in any material, however fibrous or crystalline. The electric welding process uses rather the method of the crucible than of the press for, although considerable pressures are applied during the operation, they are not beyond the limits of ordinary forging, and the essential difference is the greater heat available at the direct point where it is most needed; a heat which approaches and often reaches the melting point of the material. As the pressure is applied it is transmitted by the cold bar directly upon the softened metal and forces it to unite more readily. This view of the process brings us at once to some of the most important limitations; cast iron, cast steel, cast copper, cast brass, are not changed in their essential constitution, but are united by a weld having all the characteristics of the original bar. Now, let us take a bar of rolled zinc or drawn copper and compare it with the cast metal. We find the crystals, formerly large, and widely separated, especially in the case of zinc, where often internal oxide stains are perceptible, now are broken into minute fragments, elongated and united so closely as to allow the greatest opportunity for the action of cohesion. Weld such a metal as this, and the joint where broken will immediately show a rearrangement of the particles into longer and looser crystals similar to those of the unworked metal. By repeated fracture of the bar, you will be able to follow graduations of the action till it loses itself.

A weld of this character will give a sufficient tensile strength, but the brittleness of a coarsely crystalline material has returned. Whether such a joint is worthless is entirely a matter of circumstances. With small sections the action is not perceptible on account of the very small length heated, and also because bending, however short, does not subject the metal to so great a strain as in the case with larger sections. For a rod to be subjected to further drawing, rolling, or other like processes of manufacture, the weld is satisfactory, since the subsequent working reinstates the metal to its best condition, but for a wire to be considered a finished product, further manipulation is necessary. In view of this, the later machines for welding heavy copper have been provided with reheating clamps and light rapid hammers, by means of which the burr, after a slight trimming, can be reheated and forged; in special cases a further hammering cold is added. Though this produces a great improvement in the metal, it yet leaves a good deal to be desired where great strength and pliability are required. To produce this, a further upsetting of the metal throughout the whole heated space, and a subsequent forging will be necessary. This, up to the present time, has not been provided for, and presents a greater difficulty than is at first apparent, besides furnishing a new proof of the crystalline constitution of copper. On account of this characteristic, as is apparent on attempting upsetting in the welding machine, it offers, at a red heat capable of moving and rearranging the particles, a resistance so high to compression, that three or four times the pressure necessary for welding will not have the slightest effect towards increasing the diameter or upsetting. With bronzes the further difficulty is encountered of red shortness between the molten temperature of the weld and the malleable red temperature. That this should be so necessary and offer so many difficulties may seem strange, since the metal does not apparently exceed the temperature of ordinary annealing, and it must be that either the passage of the current by an extra disturbance helps to rearrange the particles, or else the temperature is greater than we imagine from an observation. The latter explanation seems to me to be the more likely, since our ordinary observations are made on metals heated from an external source, and of which the surface is at the highest temperature. With the weld, however, the source of heat is internal, and the surface is undergoing a continual cooling from the external air.

Welds made in the higher carbon steels are at a similar disadvantage, and must be looked upon with disfavor unless provision for upsetting and forging hot is provided. These disadvantages are especially apparent with steel wires of the highest grade, where the strength of the original material has been more than doubled by tempering and drawing. In such cases it is not ordinarily the loss of tensile strength that is to be feared, but the increased liability to snap under repeated bendings. This is especially important in the case of wire to be twisted into a running rope such as is used on our cable railroads. From this view, the weld in a whole rope where forging is impossible, would be necessarily defective, and though for a standing rope I have no doubt it would be fairly successful, yet for a running rope I believe everything tends to prove it dangerous. It has been suggested as an explanation that these effects are due to the presence of oxygen at the weld, producing sub-oxide in copper and reducing the carbon in steel. In support of this view the case of the application of oil to the hard saw teeth is cited as supplying the necessary carbon by its decomposition. It is undoubtedly a fact that by the heating of these high grade steels, and subsequent slow cooling, some of the combined carbon is changed to the graphitic form, with a consequent loss of strength, and it seems clear to me that a drop of oil at the right moment serves to restore this, or, in other words, effects a tempering. It is almost useless to attempt an explanation by a complicated chemical decomposition, when the simpler molecular rearrangement is more in accordance with the facts and a more complete explanation.

This brings us to a point where the electric welding throws light upon the actual production and nature of burnt steel. By forcing the heat in welding, no matter if rapidly, this effect can be produced as thoroughly as by the means of a fire, while if the name "burnt" was an accurate description, and the iron and carbon oxidized, a sufficient time would be necessary for its penetration into the center of a bar of metal. This agrees and is a further confirmation of the most modern ideas about burnt metal, that it is a molecular rearrangement, and by careful forging and heating the metal can be restored to its original state. In this case oxidation certainly does not take place, though the action may be similar to metamorphism in rocks; steel being at the present day looked upon as a mineral, a matrix of iron, including minerals which are generally compounds of iron with carbon, silicon, sulphur, manganese or phosphorus. Under this view there may be internal chemical rearrangement at high temperature. With carbon we know this to be the case, but I take it as settled by electrical heating that the change is not necessarily an oxidation.

The welding of two different materials, such as iron and steel or malleable cast-iron, presents another difficulty and possible danger. When such a weld is broken we find that the pressure in the plastic state has forced the iron over the steel or malleable, which has itself been merely slightly melted and cemented to the adjacent particles of the iron. This produces what might be called a reverse riveting, the hot iron having been upset over the steel and inclosing it tightly, in the place of having been upset in a hole, as in ordinary riveting. Again, as in all this work, the tensile test is but a poor test of quality, and though a weld may have within 10 or 20 per cent. the tensile strength of one of the original materials, it is a fallacy to say that, therefore, the weld is within 10 or 20 per cent. of the quality of either of them. Use here again determines the serviceableness of the process.

I am tempted here to carry further the discussion of the special cases offered, but it would only be to apply over again the observation indicated in the foregoing, and which might be finally stated that, although the electric welding process will not practically splice everything, from a bar of magnesium to a steamer shaft, yet it enables us to accomplish results otherwise impossible and if both the use of the product and the treatment of the materials be sufficiently studied, it may be trusted in its results.

Decided Against the Trolley.

The New York State Railroad Commission has decided that the Coney Island and Brooklyn Railroad Company cannot for the present change its motive power from horses to the overhead single trolley electric system on that part of its road between the corner of Franklin and Coney Island avenues in Flatbush, and the corner of Ninth avenue and Ninth street, in Brooklyn.

National Electric Light Association.

The electrical men of Montreal recently held a meeting to organize citizens' committees in connection with the August convention of the Association. It was decided to appoint a reception committee, one on amusements and others to be subsequently decided on, and for the purpose of deciding on the gentlemen to be named for these several committees, an influential sub-committee was appointed. It was resolved that the citizens should secure as many attractions as possible, in the amusement line, during the visit of the members of the Association.

The Montrealers are reported to be highly enthusiastic over the fact that the next convention is to be held in their city.

Shall "Aluminum" Be "Alium?"

READ AT THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, MAY 21, 1891, BY OBERLIN SMITH.

Although having the honor of being a member of this distinguished Society but a very short time, I take pleasure in accepting an invitation from your Committee on Papers and Meetings to say a few words regarding a proposed shorter and more euphonious name for the beautiful and valuable metal which must, perhaps, now be ranked as base rather than precious, only because recent metallurgical and electrical science has made such wonderful strides in cheapening its production.

In February, 1890, I had the pleasure of reading before the American Institute of Mining Engineers, at their Washington meeting, a paper entitled "Aluminum in Search of a Nickname." In this essay reference is made to the fact that the nickname "Al" had already been irreverently introduced by many of the people engaged in manufacturing and selling it, in accordance, obviously, with the general tendency of our modern rapid life to condense all our commercial nomenclature into as small a compass as possible. In witness of this we, in America, as well as many of the denizens of other English speaking countries, have generally adopted the word "wire" as a substitute for "telegraph," and have, by successive stages, shortened the term "elevated railroad" into "elevated road," "the elevated," "el" and, finally, "L"—the latter being spelled as briefly as possible by the ingenious device of using only one letter.

In accordance with the labor-saving tendency in regard to our tongues and pens, it certainly seems desirable that a shorter name than "aluminium," or even "aluminum," should be found for a metal which is destined to be so largely used in the further evolution of our modern mechanical life, and, probably not a little in the electrical engineering of the future. In the paper before mentioned, reference is further made to the fact that the names of the commercial metals now in use are nearly all short, crisp words of one syllable, as gold, tin, zinc, lead, bronze, brass and steel, while the most common two syllabled ones, nickel, silver and copper, are also simple and easily spoken.

In further arguing the point regarding aluminum, I suggested as possible future names "Aluum," "Alium," "Alim" and "Alm," as being suggestive of the original word for which they might become substitutes, and yet euphonious and easily pronounced. Since the essay in question was printed, my proposed reform has attracted considerable attention in the technical papers, the general preference appearing to be for the word "Alium" rather than for the others mentioned. This word has also been suggested independently by no less eminent a scientist than Prof. Elihu Thomson, who did not know that I had already proposed it. It has been heartily endorsed by Mr. Eugene H. Cowles, a well-known authority upon this metal, in an article in the New York *Tribune*, and by Mr. T. Commerford Martin, past president of this Society, in the columns of the *Electrical Engineer*.

Upon thinking over the matter further, I myself, prefer this word to the shorter ones suggested, alim and alm. The latter, as Prof. Thomson suggests to me, reminds one of alms-giving, and I think the former looks and sounds too much like "alum." It is true that "Alium" has three syllables, but they glide so smoothly into one another that it is scarcely harder to pronounce than the shorter ones mentioned, while being much pleasanter to the ear; and, as Mr. Cowles states in his interesting article, agrees in its termination with many other words used by the chemists to signify metals—as, *e. g.*, sodium, calcium, etc. Very probably these same chemists would consider it appropriate to use the word "alia" for the oxide now called "alumina." I do not feel sure about the desirability of this, but cannot, at this speaking, see any objection to the word.

It is earnestly to be hoped, if we are ever to have a shorter name than either of the two present ones, that some decided step will soon be taken by the proper authorities, if their existence and identity can be determined, to establish, once for all, a shorter and more convenient name. If the leading technical journals in this country and abroad could be induced to agree upon the word "Alium," or something better, if such can be suggested, and if, furthermore, the national engineering societies should see fit to endorse the same, the work of reform would practically be accomplished, as it is not probable that those who are strictly scientists only, would hold out against a popular verdict or the kind mentioned.

Possibly a practical method of starting this reform would consist in one of the societies mentioned (and why not this one) appointing a committee to distribute an argument of the case among the editors of the various technical journals, here and abroad, asking for replies as to how many of them would be willing to adopt the new word, should a majority of the whole number agree. This committee could also send communications to the other national engineering and scientific societies, requesting action, or, at any rate, an expression of opinion, upon the same subject. If each society proved willing to appoint one or more members upon a joint committee of conference, a favorable report by such a committee, especially if backed by the technical journals, would undoubtedly command sufficient respect to lead to the adoption of the name in question by the societies themselves at a later period.

If we consider the length of the names "aluminium" and "aluminum," in comparison with other elements, we find that the former is the only five-syllabled one extant. In a list of 64 elementary bodies we find only 18 of them to be words of four syllables, while 29 have three syllables, 11 two syllables, and five one syllable, the latter all happening to be ordinary commercial metals. The question naturally arises, can we afford to put a material which is probably destined to such entensive use as is this comparatively new and beautiful metal in the category of these rarely used and many syllabled elements which, as has been seen, are in a small minority of the whole number? Can we, moreover, afford to let it stand alone, in the whole list of elements, as the only one (excepting, perhaps, mercury, which foolishly has a sort of a synonym) possessing *two* distinct and interchangeable commercial names, as is now the case?

In enunciating the words in question, we find that although they are somewhat musical in sound, especially the longer one, they are not easy to speak rapidly, especially by a person not in the habit of pronouncing them frequently. In writing them, the evil is worse, for, in the case of "aluminium," one must, to be sure one is right, analyze and count some 28 nearly similar up and down strokes of the pen after writing "Al." Otherwise, there is apt to be a "u" or an "i" too many or too few; and even if they are right, some discretion is required in ascertaining where to dot the "i" and the "i." If the casual reader does not believe all this, he is only invited to try it as often as has the writer.

In regard to the interest of this very progressive society in the improvement and development, not only of aluminum, but of its name, I think there can be no question; as it is a metal which is already used to some extent in the electrical arts, and is destined to far greater use as it becomes cheaper, and as new inventions are made for applying it. Especially is this the case in view of the recent discoveries in France regarding certain alloys of aluminum with small percentages of copper, which show that we can double its tensile strength while increasing its weight only about six per cent. I have not heard how its electric conductivity is affected by such alloying, but if these stronger metals shall prove to be nearly as good conductors (and possibly they may be better) than is the pure metal, we at once have a bright vista opening before us for telegraph and telephone line wires of great conductivity in proportion to their weight, combined with durability and beauty. There are, doubtless, numerous other applications of the metal and its alloys to be developed in the near future, especially in electric railroading, where strength combined with extreme lightness is destined, I think, to be secured by materials and methods, the use of which will, even in this generation, produce a speed and safety of which we, as yet, can scarcely dream. In this abolishment of the old "dead-weight" system—this destruction of the cars of Juggernaut, so to speak—in which the electrical engineer is to bear so brave a part, shall we know one of the most useful materials of the new age as Aluminium, Aluminum or Alium?

Improvements in The Stanley Alternating Current Fan Motor.

Since the illustrated description of this motor appeared in the ELECTRICAL REVIEW for May 16, 1891, a few changes in the motor have been made by the Stanley Electric Manufacturing Company, Pittsfield, Mass., which are decided improvements.

The form of base has been changed so as to permit better circulation of air. Carbon brushes have been substituted in place of copper. The form of fan has been changed to one with three blades, and the diameter increased to nine inches.

Realizing that there are many places where it is not convenient to place the motor on a desk or table, the company will furnish them without base, fitted to hang from a hook on the wall, or to suspend from the ceiling, as desired.

Electric Meters.

READ BEFORE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, MAY 21, 1891, BY GEO. W. WALKER, NEW YORK.

The time has come for the central station companies to realize that they must supply the electric current in a more thoroughly commercial manner, that is, it must be sold as other commodities are sold, by measure, weight or its equivalent. To convince, however, an already skeptical public that the electric current can be measured with as great, if not greater degree of accuracy than the established and accepted methods of measuring gas, water and steam, is no small undertaking. The fact remains, however, that we have to-day a number of electric meters, which will measure the electric current more accurately and thoroughly than instruments adopted for similar purposes in other branches of business.

We have, it is true, one great question which we cannot answer, and that is, what the electric current really is. We explain this, however, by saying we can measure its effects, which are reflected either in light, heat or power. Fortunately for us, we have adopted units which are universal; the coulomb, ampere, and ohm, represent values practically the same throughout the entire world. Therefore, we start out with fixed rules which must be recognized as well by the old world as the new. Compare this fact with the different weights and measures adopted by various nations and countries and see what universal dissimilarity exists. Imagine for a moment what consternation would exist amongst the great dry-goods business if it were possible to instantly transfer all our yard-sticks to France and their meter sticks to this country; the result would be to momentarily paralyze their business. We can, however, place our measuring instruments on any circuit and the result remains the same, and is read with the same degree of certainty and accuracy by all nations.

As gas was the follower of the tallow dip, so is electricity the successor to gas, and one of the legacies inherited by us is the much abused and anathematized gas meter. The peculiarities of this somewhat venerable object are numerous, sometimes amusing, many times annoying and expensive, as our personal experience will prove. The original gas meter was a very crude affair indeed, and would insist on freezing or drying up at the wrong time. Probably many of us could tell amusing experiences which have befallen us in our endeavor to make it work. Its progress to its present state of perfection was very slow, in fact, for almost, if not quite 20 years after it was first introduced, no improvements were made upon it. Much as we blame and question its arithmetic, it is, undoubtedly, a very reliable instrument. It has, however, by comparison, caused the ever-suspecting public to look with suspicion upon the electric meter, even though they see the wheels go around.

In presenting this subject to you it may be interesting to know that although there are but a very limited variety of electric meters now on the market, this number does not in any sense represent the thought and time that has been given to this particular branch of the electric field. A perusal of the United States patent office reports shows that, up to date, about 185 patents have been granted on electric meters alone. The first patent granted by our government on electric meters was No. 132,569, dated October 29, 1872, and issued to S. Gardiner, Jr., of New York city. The principle of this meter consists of an electro-magnet, having its armature connected to a releasing device of a clock movement. The dials of said movement indicate the time during which an electrical current is in action.

No further patents were issued until the year 1878, during which year a patent was granted to W. E. Sawyer, also of New York city. The same month, November 26, a patent was issued to Jim Billings Fuller, of Brooklyn, N. Y., on what was, perhaps, the first alternating meter invented. His invention is embodied in one claim which reads as follows: "An electric lighting system in which the light is produced by alternating currents—an electro-magnet placed in the main or induced current circuit, or in a shunt therewith connected and having a polarized armature, the vibrations of which actuate a train of registering wheels, substantially as and for the purpose specified."

The patents granted to Sawyer and Fuller were the only ones issued in 1878. One patent was granted in 1879; three in 1880; seven in 1881; seven in 1882; eight in 1883; nine in 1884; five in 1885; 12 in 1886; 13 in 1887; 22 in 1888; 36 in 1889, and about 60 during the year 1890 and up to the present time. You see, therefore, that considerable time, brains and money have been expended in the direction of perfecting the electric meter.

A careful examination of the 185 patents issued, revealed many ingenious devices for the measurement of the electric current; but, in most cases, the expense of manufacture, the likelihood to derangement and the cost of operation kept these meters out of the race, from a practical standpoint. It would be impossible, in the time allowed for this paper, to describe a great many meters. I presume you will be interested only in those which have been placed prominently and in a commercial manner before the American public. I will take them up according to their seniority and describe them as briefly as possible. The first to consider is the

EDISON ELECTROLYTIC METER.

The fundamental patent taken out by Mr. Edison on his chemical meter, is No. 251,545, dated December 27, 1881. In the patent an electro-magnet is claimed as part of the meter; the principal claim, however, is in the use of an electrolytic cell placed in a shunt circuit, the resistance being so proportioned that a definite fraction of the current passes through the cell. The chemical action of this meter when in use, consists in depositing metal from one electrode to another, the rate of deposit being regulated by the amount of current passing through the meter. The electrical energy consumed is measured by ascertaining the increase of weight of the electrode which receives the deposit. Subsequent to the issue of this patent, he devised various modifications of this meter, introducing recording devices as in patent No. 304,082, which provides for the use of two electrolytic cells, one plate of each being suspended from the beam of a sensitive balance, the circuit being so arranged that one cell is in circuit at a time, the direction of current in that cell is such that the electrolytic action in same will throw the balance out of equilibrium, causing the beam to kick and by that action throw the current to the other cell and register one on the counter. Various other devices were patented and experimented upon by Mr. Edison to accomplish similar results. He also devised a meter upon the motor principle, a patent for which was allowed him June 14, 1881, No. 242,901. However, he finally adopted the electrolytic cell meter pure and simple as the one to offer to the public in a commercial sense.

The meter as used to-day by the Edison Company is but a slight modification of the original plan. A. E. Kennelly, in a paper which was read before the Association of Edison Illuminating Companies, at Minneapolis, is my authority for stating that the bottles, plates and resistance in the present three-wire Edison meter are of a uniform size without regard to the size of the meter. For example, it is so arranged in the smallest meter that each milligramme of weight transferred represents one ampere hour of supply, the rate of transfer being ten milligrammes per hour at a full load. In a No. 8 meter each milligramme of deposit would represent eight ampere hours, a No. 4 meter four ampere hours, etc. The meter number being the index of the supply in each case. It is claimed that making all bottles, plates and resistances uniform in size has simplified, in some degree, the handling of this meter. Whilst this may be the case, we must not lose sight of the fact that another constant has been introduced which is governed by the size of the meter. This, together with the fact that only $\frac{1}{5\,0\,0}$ part of the current supply passes through the meter, allows a possibility of quite a large error. I will not weary you with a disseration on bottle resistance, oxidation, the correctness of the German silver shunt, etc., etc. I will merely add that, although the Edison electrolytic meter has been criticized very severely by many prominent electricians, and much has been said *pro* and *con* about it, we must all acknowledge that it has been introduced quite extensively by the Edison Company, and has, in a commercial sense, at least, proven a success.

THE SHALLENBERGER METER.

This meter is of the motor type and devised for the alternating current only. The first patent allowed to Mr. Shallenberger, was No, 388,003, and dated August 14, 1888.

The elements employed in the construction of this meter are, first, an armature of metal capable of rotation; second, an electric circuit which is so arranged that when it is traversed by alternating electric currents, a field of force is induced, having a given polar line or axis with reference to the armature; and third, a circuit so regulated to the first circuit that currents are produced in such second circuit by the action of those in the first, the phases of which succeed those of the currents in the first circuit, and set up for the armature a second field of force, the axis of which intersects that of first. To the armature is attached a shaft, which by a worm gear operates a suitable dial train, representing the number of revolutions made by the armature. Means have been provided to retard the speed of the armature by introducing a set of fans or vanes, which are also attached to the shaft. It is claimed by the inventor that the retarding effect produced by the fans or vanes should increase as the square of the speed, inasmuch as the tendency of rotation increases as the square of the current; whether this has proven to be a fact, those who have used this meter can best decide. Like all other motor meters the difficult points to solve, are to produce proper speed on very light load and have the retarding action correct as the load increases and your motor commences to hump itself along. Mr. Shallenberger has recently taken out a number of patents consisting of improvements and modifications of his original claims. One of his recent devices provides for cutting the meter out of circuit when all the lamps have been turned off; it has been found that even though all lamps are out, there is still a leakage occasioned by the transformer and the inventor concludes it to be unwise to ask the consumer to pay for such leakage.

The patents of Mr. Shallenberger are now owned and controlled by the Westinghouse Electric Company, and this meter has been introduced by them quite extensively both in this country and abroad.

THE ARON METER, INVENTED BY DR. ARON, OF BERLIN, PRUSSIA.

This meter has, as its underlying principle, the ascertaining of current consumed by noting the difference in the rate of movement of two clocks, one of which is affected by the electric current passing. The apparatus consists substantially of two pendulums regulated so as to have synchronous oscillations. The left-hand pendulum is of usual construction; the right-hand pendulum carries at its extremity as weight, a steel magnet. Each pendulum is kept swinging by a clock movement actuated by spring power. Both pendulums act jointly upon one dial train, which counts the difference of their oscillations. As long as no current passes through counter coil fixed below the magnetic pendulum, both pendulums oscillate synchronously and the dial train is at rest; as soon, however, as the current passes through the large coil, the time of oscillation of the magnetic pendulum is affected, so that it swings faster as the current passing through the coil increases, the dial train registering the oscillation of the magnetic pendulum. In order to take a reading of the current consumed it is necessary to multiply the degrees marked on the dial by the constant, which is determined for each meter individually. The clocks are supposed to run 30 days with one winding.

This meter has been introduced quite extensively in Berlin. Judging from its general construction it should give very accurate results if operated under favorable conditions. Its size and cost, however, have prevented any general adoption of it in this country. I understand their representative in America has concluded to give up the fight and return to Berlin. This, I understand, was hastened somewhat by the passage of the McKinley bill, which imposed such heavy duties on their importation as to make it impossible to compete successfully with the other meters in the market.

THE THOMSON WATT METER.

Prof. Elihu Thomson has probably been the most prolific inventor of electric meters, as the patent office reports will prove.

Previous to bringing out his watt meter, Prof. Thomson's efforts were largely directed in perfecting what might be termed vapor meters. The general principal of this character of meter being the evaporation by heating effect of fluids, such as alcohol, ether and water, such fluids being confined in sealed vessels or chambers. Each motor provides for the use of two or more glass chambers, such chambers being connected by a suitable glass tube and then delicately poised. By the heating effect of the passing electric current a change in the weight of one or the other of the vessels is produced which disturbs their equilibrium, and by a suitable arrangement counts their oscillations upon a dial train. Prof. Thomson has devised many interesting devices operating on this principle, but unfortunately they did not appeal to the commercial public in a favorable manner.

His most recent invention, and the one which has been adopted by the Thomson-Houston Company, is what is known as the Thomson watt meter.

This meter is of the motor type and consists of set of coils wound on a hollow frame forming what might be termed a Siemens armature of polygonal outline, without any iron core. Passing through this armature is a vertical shaft which rests in jeweled bearings at the top and bottom. The coils of the armature are connected to a commutator carried on the shaft near its upper bearing; two light springs bear upon this commutator and constitute the brushes. The coils of the armature are wound with fine wire and have, in circuit with same, resistance which is wound according to the voltage required. The armature and resistance are usually connected in shunt across the mains. The armature has surrounding it a set of fixed coils, forming the field magnets, through which the current to be measured passes. Attached to the shaft which passes through the armature is a gear which engages with a train of dials or counters for the purpose of recording the revolutions of the armature and, consequently, the amount of current consumed. The means provided to regulate the speed of the armature consists of a copper disk which is also attached to the armature shaft. This disk rotates between the poles of a number of permanent magnets, and is retarded by their influence. In this case, as in other meters of this type, the difficulty of securing proper speed for light load, and regulation on heavy load, is the great question to overcome.

The claim that this is an absolute watt meter, I fail to see the justice of, inasmuch as the armature and resistance must be specially wound for any given voltage. For example, a meter wound for a 110 volt circuit will not operate correctly on a 60 or 75 volt circuit and *vice versa*. In fact, it is absolutely necessary to correctly wind the armature and resistance for the given voltage of the circuit upon which the meter is to be used.

The tendency of this meter to continue to operate after all lamps have been turned off, has, it is claimed, been in a measure overcome by the use of brass instead of iron in the frame of the meter; however, the permanent magnets surrounding the copper disk seem to give out lines of force creating a field for the armature, which is usually in shunt across the mains, and in case the armature and resistance are not adapted to the voltage of the circuit, the meter will continue to operate for or against the consumer.

The principle embodied in this meter is not new, and it is only fair to add that as far back as the years 1883 and 1884, patents Nos. 233,547 and 304,881 were taken out by M. Edward Weston, on a meter of similar construction. The claim of Mr. Weston's patent provides for the use of a meter in which the armature is connected across the mains and a suitable device for regulating the speed of same, also a dial train to record the number of revolutions made by the armature representing the amount of current consumed. Mr. Weston's method of controlling the speed of the armature provides for the moving of one of the field magnets to and from the armature, otherwise the principles embodied in these two meters seem very similar.

The meters which have thus far been described all provide for measuring the amount of current consumed in a culminate manner, either by a series of dials or by ascertaining the amount of metal deposited on an electrode. Therefore, any question as to the correctness of the result attained cannot be explained in detail. As I stated before, the gas meter is our legacy, and strange to say, the efforts thus far made by inventors have been to produce a meter resembling the gas meter as much as possible, both in its appearance and operation. The meter which I will next describe is the one with which I am most familiar, and which differs in its operation from any thus far brought to your attention.

THE WALKER METER.

It has been usual in testing any electric meter to place in the circuit with same, an ammeter, for the purpose of proving the correctness of the meter's operation. Assuming this hypothesis to be correct, we have in the Walker meter the element of a test instrument, inasmuch as the meter consists principally of an ammeter which measures all the current passing, and records by photography the various positions occupied by the ammeter needle. The use of photography in this case is to eliminate the element of friction in the meter. When I use the word photography, I do not wish to imply that there are lenses or any of the necessary devices pertaining to the photographic art to contend with. The apparatus is simply so arranged that the ammeter needle-point is represented by a speck of light, and as the needle moves its position this point of light traces an image on the sensitive paper which is immediately behind same. In other words, we are practically photographing the position of the ammeter needle during such time

as it is being affected by the passing current, and the result is a continuous line marked upon the sensitized paper, representing the fluctuations of the ammeter needle.

In detail, the meter consists of an ammeter coil or solenoid, in which an iron wire in the shape of a nearly complete circle is placed as a core. The same shaft to which the circle or core of the ammeter is attached, has also fixed thereto a light aluminum sector provided with a fine vertical slot; this slot representing the needle or pointer of the ammeter. Immediately behind this sector is a box which encloses a roll of sensitized photographic paper. The screen placed between the sector and the box, has a horizontal slot before which the sensitized roll is made to pass.

The vertical slot in the sector is so arranged as to come at right angles with the slot in the screen, so that in whatever position it may be, it will always allow a point of light to pass from the lamp which is enclosed in the meter on to the roll of sensitized paper.

Perforations in the screen representing the calibration of the instrument cause continuous horizontal lines to be printed on the sensitized paper. Another horizontal slot below these perforations is covered by a shutter which is opened every hour by the clock movement and causes vertical lines to be printed across the sensitized paper, representing hours of service. The number of the meter is also printed every hour just above this hour line. Means have been provided for causing a continuous movement of the paper roll at a given speed and this is effected by the use of a small clock movement, which is wound automatically by the electro-magnet placed in shunt circuit with the lamp in the meter. The clock movement remains stationary and the lamp goes out when no current is on the circuit, but both start up immediately upon the lighting of a single lamp. In this way there is impressed upon the moving paper roll a complete record, in a detailed manner, of the current consumed in the circuit for a given time.

The roll of paper after a certain time, say one month, is taken from the box and developed in the usual manner, so as to fix the light impressions. It can then be measured up in the same way as an indicator card, by the use of the planimeter. The consumer is, therefore, at any time able to check the charges made and the records being permanent can be used for future reference. It is evident that a large number of rolls can be developed in the same time required to handle a single one, in fact the number is restricted only by the size of the vessel used. In the meter as at present manufactured, each square inch on the diagram represents 16 ampere hours, therefore, the total number of square inches measured by the planimeter need only be multiplied by 16 to arrive at the sum total of the energy consumed. The loss in operating this meter is confined to the energy required to burn one lamp in the meter which at the candle-power used takes one-sixteenth of an ampere. This is the maximum loss whether the current of one or a thousand lamps are being measured, the ratio of loss decreasing as the load increases.

The only care required in operating this meter is in placing the sensitized paper in the holder. In order to do this satisfactorily, a dark room should be built in a convenient portion of the station, a window of dark yellow glass in this room will provide plenty of light to the operator, but if more light is required this window can be covered with yellow post office paper and an incandescent lamp suspended before it. The sensitized paper in rolls of sufficient length for one month's use comes in sealed packages and must only be opened and placed in the holder in the dark room. A boy can be instructed to collect the boxes as skill is not required. As stated before, the meter number is printed on the diagram every hour, therefore, it is not necessary to keep any record of the box itself.

It is evident that a meter which provides means to compute the current consumed, in a detailed manner, had advantages which other meters do not possess, inasmuch as any question as to the correctness of bills rendered can be satisfactorily explained by referring to the diagram or chart made by the meter which is in dispute.

The patent office reports show numerous devices for securing the record of the ammeter needle on a moving strip of paper by the use of a syphon pen or pencil. In all such cases, however, the element of friction is so apparent as to make their use prohibitive.

The patent granted to W. C. Patterson, No. 333,779, issued January 5, 1886, and another to myself, No. 406,678, dated July 9, 1889, are the only ones which cover the use of paper which is sensitive to light in combination with electrical measuring devices. I regret that my time will not allow me to describe several other meters which have been presented to the American public, as well as meters of recent foreign production.

The subject matter is too extensive to include in one paper, and probably may be taken up at some future day and more fully presented.

Small Edison Slow Speed Motors.

The field of the electric motor is constantly and rapidly broadening, owing to the great convenience, economy, cleanliness, compactness and almost noiseless running of this new form of power. The list of machinery that is at present operated by the small type of electric motor is much larger than would appear possible. In that list will be found small pumps, drill presses and other tools, small fans and blowers, sewing machinery, small lathes, buffing wheels, cloth and paper cutting machinery, organ bellows, printing presses, etc., etc. In a word, wherever power is required the electric motor is the ideal means of supplying it.

Fig. 1.—New Edison Slow Speed Motor.

The uses for small motors, that is, from one-sixteenth of a horse-power to one-half horse-power, inclusive, are surprisingly numerous. Work formerly performed by hand is now, for the first time, done by power; and every day some new application of the small electric motor is made.

Most of the small motors on the market are merely small machines of the same type as the large ones. But there are a great many considerations which apply to small motors and not to large ones, and by a proper design a great many advantages are obtainable which cannot be obtained in the case of larger motors.

Appreciating these facts, Mr. Edison has designed a motor with special reference to its use in small sizes.

Perhaps the most important benefit which the electric motor secures to the user of power is the great reduction of wearing parts, and the very small amount of attention which is needed for its operation. These advantages are realized in the Edison motor. By connecting the coils of the armature with the commutator by German silver wires, the sparking which has heretofore been found so objectionable in small machines is entirely eliminated. This is a feature which will be at once appreciated by power users. The motor has been so designed that no adjustment of the brushes whatever is required, the brush holders being fixed in position and requiring no attention after being once adjusted. Lubrication being accomplished by the use of grease instead of oil, very little attention is needed in that particular.

As each coil of the armature is wound independently of the others, any coil can be replaced with the greatest ease, and without disturbing any of the others.

Fig. 2.—Armature of New Edison Slow Speed Motor.

The bearings of the armature shaft consist of removable brass sleeves, which are adjusted to permit of perfect alignment. Upon the wearing of the brass bearings by continued use, they can be readily slipped out and new ones substituted in a few minutes, placing the motor in as good running condition as if it were new.

The general arrangement of the motor is shown in Fig. 1. The armature revolves in a magnetic field, the lines of force being brought through the armature on both sides of the ring by means of specially shaped pole-pieces made of the softest Norway iron.

The poles being built in strips, secure a lamination which prevents the heating of the fields, thus permitting the motor to run cool even when overloaded. These wrought iron pieces are attached to the magnetic frame, which at the same time forms the base upon which the machine is mounted.

The single field magnet coil is placed below the armature. This brings the center of gravity down low, and hence adds to the steadiness and solidity of the machine.

The armature, Fig. 2, is built of the softest laminated wrought iron, and is provided with teeth. The coils are placed in hollows formed by these teeth, which secure them firmly in position, give them a positive driving arrangement, and prevent slipping of the coils.

This construction also allows the projecting teeth to be brought in the closest possible proximity to the pole pieces, so that the field magnets can be brought very close, lessening the air gap, without the slightest danger of abraiding the winding of the armature.

These motors have been designed to meet the demand for a highly efficient machine which would be at the same time of low cost, and this object has been accomplished in the adoption of a type employing the smallest number of parts with the lowest possible weight of material.

The great desirability of slow speed in the operation of the electric motor has been recognized by the Edison General Electric Company. Thus the one-quarter horse-power has but 1,300 revolutions per minute. This reduction results in a great saving in the wear of commutator, bearings and brushes.

It also greatly reduces the noise and vibrations which have been found so annoying in the many older forms.

The details of the mechanical construction of the new Edison motor have been as carefully considered as the electrical features, and both material and workmanship have received the same care and attention as the largest machine built by the company.

Thus the commutator is made with large wearing surface, and the segments are insulated with mica. Lubrication is thoroughly provided for, grease and drip cups being fitted to all bearings. Experience has shown that grease is far more convenient and cleanly in practice, and better suited to the uses of these small motors than oil. No spattering nor soiling takes place when grease is employed.

The armature of the motor is provided with a guard, which protects it from accidental injury, and also forms a partial cover for the machine. All parts of the motor are made interchangeable so that new parts can be fitted without trouble. The machines are equipped with a mahogany switchboard, upon which are mounted the terminals for making circuit connection, and also a strong and simple switch, together with a safety fuse for protecting the motor from excessive current.

This type of machine is built in sizes from one-sixteenth to one-half horse-power. The following table gives the various speeds, currents and weights:

Type in h. p.	Volts.	Amp.	Speed.	Weight.
1/16	125	.4	2,200	14¾
1/8	125	.8	2,000	20¼
1/4	125	1.6	1,300	28½
1/2	125	3.2	1,500	37⅝

Type in H. P.		1/16	1/8	1/4	1/2
General Data.	Rating in K. W.	.050	.100	.300	.400
	Volts.	125	125	125	125
	Speed.	2200	2000	1800	1500
	Weight.	14¾	20¼	28½	37⅝
Over All.	A	6¾	10¼	10 1/16	10¾
	B	7¾	7¾	7¾	8
	C	7¾	7½	9¾	10¾
General.	D	3½	6 5/16	6½	7
	E	2⅜	3	4⅛	4¾
	F	5¼	5¾	5¾	6
	G	4⅜	4¾	5¾	6
Base Frame.	K	7¼	8¼	8¾	9
	J	7	8	8⅛	9
	H	¾	⅞	⅞	1
	L	⅝	1	1⅛	2
Pulley.	M	1 1/16	1 1/16	2¼	3
	N	1/16	⅛	⅜	⅜

KINDRED INTERESTS

The Dwight Slate Machine Company, Hartford, Conn., have issued a new illustrated catalogue of their machine tools.

E. S. Ritchie & Sons, Brookline, Mass., have sent us a catalogue of electrical test instruments of which they make a specialty.

The Consolidated Electric Storage Company, New York and Philadelphia, show their secondary batteries in fine illustrations in their new catalogue.

The Berlin Iron Bridge Company, East Berlin, Conn., have issued a finely illustrated catalogue showing a large number of iron structures erected by them for companies all over the country.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., have issued a beautiful little catalogue, describing their alternating current fan motor, illustrated in the REVIEW, of May 16, 1891. The catalogue is the work of Bartlett and Company, engravers and printers, New York.

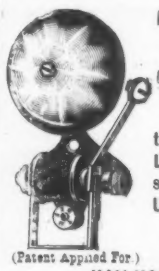
The Western Express, of the Pennsylvania railroad, is the great evening train out of New York. It leaves stations foot of Cortlandt and Desbrosses street daily, at 6.30 P. M., for the cities of the West, delivering its passengers in Chicago, Cincinnati and St. Louis, at the most seasonable hours. It is completely equipped with Pullman vestibuled sleeping and dining cars.

The Eureka Tempered Copper Company, of North East, Pa., report that their largely increasing business has necessitated the enlarging of their plant, and they are now laying the foundation for a new moulding room, 50 feet by 140 feet hoping that the increased facilities which this addition will afford may enable them to meet the increasing demand for their tempered copper.

Keasbey's Coverings.—The pipes in the Buffalo Street Railway power station, are to be covered with Keasbey's Magnesia Sectional Covering. The contract was given by the Field Engineering Company to Mr. Robert A. Keasbey, 58 Warren street, New York, early last week. Mr. Keasbey reports a wonderful business within the last few weeks, and between the 4th and 18th of May, sold 18,000 feet of Magnesia covering alone. He is still anxious for new business, large or small, and solicits correspondence, which he will give his personal attention.

The Berlin Iron Bridge Company.—The new buildings for the Baltimore Electric Refining Company, at Baltimore, Md., will be made of iron designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn. The rolling mill will be 56 feet in width by 180 feet in length. The refinery building will be 130 feet in width by 80 feet long and the boiler house will be 49 feet in width by 50 feet long. The buildings will be entirely of iron, no wood work being used about the construction in any way.

The Electric Merchandise Company, 11 Adams street, Chicago, report the following: "During the last few months we have received a number of orders from tramway companies in foreign countries, and have also received inquiries almost daily regarding the practical working of electric street railways in this country. This has led us to carefully look into the matter, and after correspondence with parties interested, we believe that foreign roads are ready to adopt the electric railway system as used in this country at once, if the advantages can be fully explained to them. Our Mr. Frank X. Cicott having spent some months last year traveling in Europe, also became convinced of this fact. Believing that it would be to our interest to be early in the field, we decided to send Mr. Cicott as our representative to foreign countries, and he sailed on the Cunard steamship 'Servia,' on Saturday, the 9th inst., to spend probably two months in working up an interest in such matters."



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Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 72 in. x 60 in. x 15 ft.; 72 in. x 60 in. x 20 ft.

Friction Shapers, 15 in., 16 in., 20 in., 22 in., 32 in.

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20 Lincoln Pattern Millers, No. 2.

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PROPOSALS FOR MISCELLANEOUS ARTICLES.

OFFICE OF LIGHT-HOUSE ENGINEER, THIRD DIST.
TOMPKINSVILLE, N. Y., MAY 14, 1891.

Sealed proposals will be received at this office until 12 o'clock M., Thursday, the 28th day of May, 1891, for furnishing Miscellaneous Articles for the Light-House Establishment. The articles needed consist of twenty-one numbered lots, embracing, respectively, Charcoal and Cumberland Coal; Building Material; Engineers' Supplies; Hardware, Tools, etc.; Iron and Steel; Belting; Graphite Paints, etc.; Lumber; Boiler Covering; Plate Glass; Galvanized and Russia Sheet Iron, Tin, Solder, Sheet Zinc, and Iron Wire; Sheet Brass and Copper; Composition, Brass, and Nickel Castings; Bells; Acids; Iron Castings; Sheet-Iron Smoke-Stacks for Boilers; Electrical Supplies; Electroplating Supplies; Shooks for Oil Supply Boxes; and Miscellaneous Articles; all of which are enumerated in the specifications attached to the form of bid, which may be obtained on application to this office. Samples may be seen or information obtained at this office concerning any article not sufficiently described in the specifications. Bids will be received for one or more numbered lots complete. Envelopes containing proposals should be indorsed "Proposals for Miscellaneous Articles." The right is reserved to reject any or all bids, to strike out any item or items in the specifications, and to waive any defects. Bidders are invited to be present at the opening of proposals.

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON MAY 5, 1891.

452,359 Electric switching apparatus; George T. Briggs, Windsor, Conn.

452,367 Electric light fixture; John G. Fisher, East Saginaw, Mich.

452,397 Electric push-button; Max Straus, Baltimore, Md.

452,420 Dynamo-electric machine or motor; Ferdinand A. Wessel, Brooklyn, N. Y., assignor to the Excelsior Electric Co., New York, N. Y.

452,422 452,423 Controlling device for electric motors; Francis O. Blackwell, New York, N. Y., assignor to the Thomson-Houston Electric Co. of Connecticut.

452,424 Electric synchronizing device for clock hands; Albert M. Church, Chicago, Ill.

452,429 Electric motor; Elisha Gray, Highland Park, Ill.

452,494 Leading-in wire for incandescent electric lamps; Reginald A. Fessenden, Roseville, N. J.

452,506 Electric signal apparatus for fire hose; Jacob F. Klumpp, Jr., Louisville, Ky.

452,510 Insulated electric conductor; James B. Williams, Oakland, Cal.

452,515 Electric railway train signal and recorder; Fred. H. Brown, Chicago, Ill.

452,516 Joint for electric conductors; Edward Carroll and Thomas B. Lambert, Chicago, Ill.

452,523 Electric insulator. 452,645 Insulator holder for electric railways; Byron Jennings, San Jose, assignor of one-half to James Brusie, Oakland, Cal.

452,542 Trolley device for electric railways; David W. Cook, Salem, Mass.

452,546 Wind apparatus for generating electricity and charging secondary batteries; James M. Mitchell, Lawrenceville, assignor of one-half to William A. Camp, Greenway, Ga.

452,565 Glass-covered electric wire; Wm. Curry, Baltimore, Md.

452,571 Electric device for harness; Albert B. Holson, Chicago, Ill., assignor of thirty-seven fiftieths to Robert J. Zorge and S. Whipple Gehr, both of same place.

452,574 Rheostat; Charles D. Jenney, Indianapolis, Ind., assignor to the Jenney Electric Motor Co., same place.

452,576 Crossing for overhead trolley wires; John Kuehnle, Detroit, Mich.

452 585 Annunciator drop; Howard C Shivler, Brooklyn, N. Y.

452,602 Dynamometer; James Emerson, Willimansett, Mass.

452,611 Conductor for electric railways; Edward W. Mitchell, Spokane Falls, Wash., assignor, by direct and mesne assignments, of one-fourth to Russel Parker, James H. Stearns and Benjamin F. Sutton, Brooklyn, N. Y.

452,621 Motor mounting of electric cars. 452,622 Electric railway car; Sidney H. Short, Cleveland, O., assignor to the Short Electric Railway Co., same place.

452,633 Electric arc lamp; Frank Buchanan, Lima, O.

452,636 Telephone transmitter; Philip Fitzsimmons, Birmingham, Ala., assignor of one-half to Patrick H. Linnehan, same place.

452,638 Sectional shade for incandescent electric lights. 552,701 Shade for incandescent electric lights; Albert F. Gärtner and John C. Harris, Savannah, Ga.

452,717 Electric motor or generator. 452,718 Bi-polar dynamo or motor; Andrew L. Riker, New York, N. Y.

EXPERIENCED ELECTRICAL ENGINEER, well up in Electro-Mechanics, good at experimenting and technical reports, will be disengaged on May 1st. Highest references.

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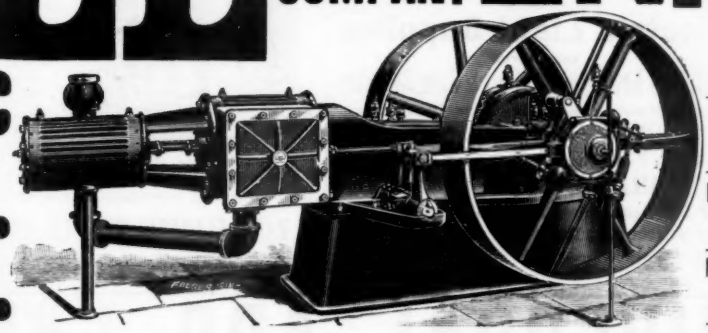

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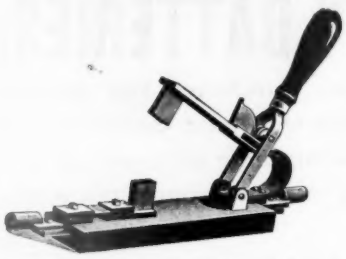

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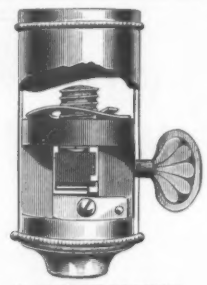

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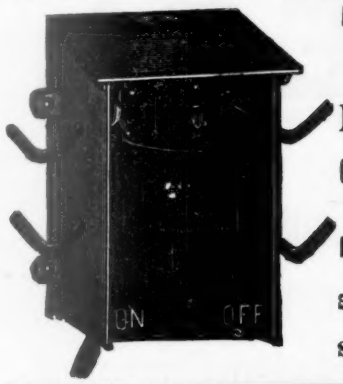

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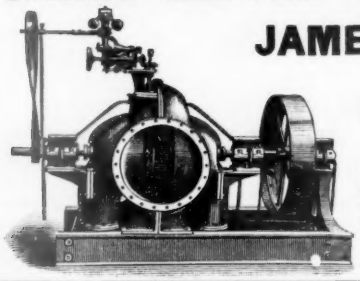

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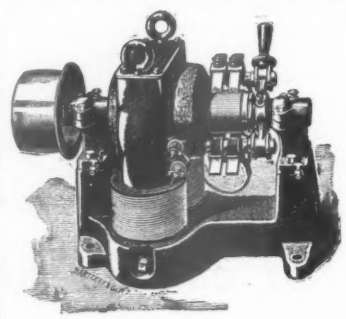

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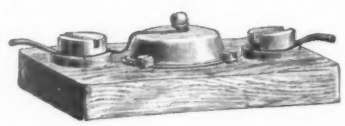

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